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Dental health and school-based health education among 15-year-olds in Tehran, Iran

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Academic dissertation

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"O Thou from whom the universe exists, before whom naught that being has has been!

Beginning of all things when things began, and at the end the End of everything!

O Raiser of the lofty sphere, of stars Illumer, of their meetings Orderer!

Author of (all) the stores of bounteous gifts, of all existent things Creative Power!

Through Thee are well disposed the affairs of all, O All Thyself and Author (too) of all!"

Nezāmi-ye Ganjavi, Iranian poet (1141-1209 A.D)

Abstract

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The aim of the present study was to assess dental health and its determinants among 15-year-olds in Tehran, Iran and to evaluate the impact of a school-based educational intervention on their oral cleanliness and gingival health.

The total sample comprised 506 students. Data collection was performed through a clinical dental examination and a self-administered structured questionnaire. This questionnaire covered the student's background information, socio-economic status, self-perceived dental health, tooth-brushing, and smoking. The clinical dental examination covered caries experience, gingival status, dental plaque status, and orthodontic treatment needs. Participation was voluntary, and all students responded to the questionnaire. Only three students refused the clinical dental examination. The intervention was based on exposing students to dental health education through a leaflet and a videotape designed for the present study. The outcome examinations took place 12 weeks after the baseline among the three groups of the intervention trial (leaflet, videotape, and control). High participation rates at the baseline and scanty drop-outs (7%) in the intervention speak for reliability of the results.

Mean value of the DMFT (D=decayed, M=missing, and F=filled teeth) index of the 15-year-olds was 2.1, which comprised DT=0.9, MT=0.2, and FT=1.0 with no gender differences. Dental plaque existed on at least one index tooth of all students, and healthy periodontium (Community Periodontal Index=0) was found in less than 10% of students. Need for caries treatment existed in 40% of students, for scaling in 24%, for oral hygiene instructions in all, and for orthodontic treatment in 26%. Students with the highest level of parents' education had fewer dental caries (36% vs. 48%) and less dental plaque (77% vs. 88%). Of all students, 78% assessed their dental health as good or better. Even more of those with their DMFT=0 (73% vs. 27%) and DT=0 (68% vs. 32%) assessed their dental health as good or better. Smokers comprised 5% of the boys and 2% of the girls. Smoking was common among students of less-educated parents (6% vs. 3%). Of all students, 26% reported twice-daily tooth-brushing; girls (38% vs. 15%) and those of higher socio-economic background (33% vs. 17%) did so more frequently. The best predictors for a good level of oral cleanliness were female gender or twice-daily tooth-brushing. The present study demonstrated that a school-based educational intervention can be effective in the short term in improving the oral cleanliness and gingival health of adolescents. At least 50% reduction in numbers of teeth with dental plaque compared to baseline was achieved by 58% of the students in the leaflet group, by 37% in the videotape group, and by 10% of the controls. Corresponding figures for gingival bleeding were 72%, 64%, and 30%.

For improving the oral cleanliness and gingival health of adolescents in countries such as Iran with a developing oral health system, school-based educational intervention should be established with focus on oral self-care and oral health education messages. Emphasizing the immediate gains from good oral hygiene, such as fresh breath, clean teeth, and attractive appearance should be key aspects for motivating these adolescents to learn and maintain good dental health, whilst in planning school-based dental health intervention, special attention should be given to boys and those with lower socio-economic status.

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خلاصه

رضا یزدانی. بررسی وضعیت سلامت دهان ودندان ونتایج اجرای مداخله آموزشی در دانش آموزان 15 ساله ایرانی در شهر تهران در سا ل 1386 . گروه سلامت دهان و دندانپزشکی اجتماعی، دانشکده دندانپزشکی، دانشگاه هلسینکی، فنلاند، 1388 . 71 صفحه. ISBN 978-952-10-5461-7

هدف این مطالعه بررسی وضعیت و تعیین کننده های سلامت دهان ودندان در دانش آموزان 15 ساله شهر تهران و ارزیابی اثرات مداخله آموزشی بر وضعیت بهداشت دندانها و سلامت لثه آنها بود.

در این مطالعه 506 دانش آموز در شهر تهران مورد بررسی قرار گرفتند. معاینه کلینیکی و پرسشنامه روشهای جمع آوری اطلاعات در این مطالعه بودند. سوالات پرسشنامه شامل سوالات زمینه ای، وضعیت اجتماعی اقتصادی، خود ارزیابی وضعیت سلامت دهان و دندان، زمان و تعداد دفعات مسواک زدن و کشیدن سیگار و معاینه کلینیکی شامل بررسی وضعیت پوسیدگی دندانی، وضعیت لثه، میزان پلاک دندانی و نیازهای درمان ارتودنسی می گردید. مشارکت در مطالعه اختیاری و تمامی دانش آموزان به پرسشنامه های خود پاسخ دادند و تنها سه نفر در معاینه کلینیکی شرکت نکردند. مداخله آموزشی با بکارگیری بروشور و فیلم ویدیویی انجام گردید که بطور اختصا صی برای این مطالعه طراحی و تهیه شده بودند. نتایج مداخله آموزشی بعد از 12 هفته در سه گروه بروشور، گروه فیلم ویدیویی و گروه کنترل مورد بررسی قرار گرفت. در صد بالای مشارکت دانش آموزان در شروع مطالعه و حذ ف درصد کم دانش آموزان (7 درصد) در پایان مطالعه نشان از دقت نتایج این مطالعه دارد.

میانگین DMFT در این گروه سنی برابر 2.1 واجزاء این شاخص شامل DT=0.9, MT=0.2, FT=1.0 بدون تفاوت آماری در دو جنس بود. پلاک دندانی حداقل در یک دندان شاخص در تمامی دانش آموزان و لثه سالم (CPI=0) در کمتر از 10 در صد دانش آموزان مشاهده گردید. 40 در صد دانش آموزان نیاز به درمان پوسیدگی دندانی، 24 در صد نیاز به جرمگیری و تمامی دانش آموزان نیاز به آموزش بهداشت داشتند. دانش آموزانی که والدین با بالاترین میزان تحصیلات داشتند پوسیدگی دندانی (36 در مقابل 48 درصد) و پلاک دندانی (77 در مقابل 88 در صد) کمتری نیز داشتند. 78 در صد دانش آموزان بیان نمودند که وضعیت سلامت دهان و دندان خوبی دارند. بیشتر دانش آموزانی که DMFT=0 (73 در مقابل 27 در صد) و DT=0 (68 در مقابل 32 درصد) بیان نمودند وضعیت سلامت دهان و دندان خوبی دارند. 5 در صد از پسران و 2 در صد از دختران سیگار می کشیدند. کشیدن سیگار در دانش آموزانی که والدین با تحصیلات پایین داشتند بیشتر بود (6 در صد در مقابل 3 در صد). 26 در صد کل دانش آموزان بیان کردند که دوبار در روز مسواک می زنند. دوبار در روز مسواک زدن بیشتر در دختران (38 در صد در مقابل 15 در صد) و آنهایی که وضعیت اقتصادی، اجتماعی خوبی داشتند (33 در صد در مقابل 17 درصد) مشاهده شد. بهترین پیش بینی کننده برای بهداشت خوب دختر بودن و یا دو بار مسواک زدن در روز بود. مطالعه حاضر نشان داد که مداخله آموزشی در مدارس در کوتاه مدت میتواند در بهبود وضیعت بهداشت دندانها و سلامت لثه ای نوجوانان موثر باشد. حداقل 50 در صد کاهش در تعداد دندانهای با پلاک دندانی در مقایسه با قبل از مداخله در 58 در صد گروه بروشور، 37 درصد گروه فیلم ویدیویی و 10 در صد گروه کنترل مشاهده شد. نتایج مشابه برای بهبود وضیعت سلامت لثه به ترتیب 72، 64 و 30 در صد بود.

برای بهبود وضیعت بهداشت دندانها و لثه نوجوانان در کشورهایی همانند ایران با سیستم سلامت دهان و دندان در حال تغییر مداخله آموزشی در مدارس باید با تاکید بر مراقبتهای فردی و پیامهای اصلی سلامت دهان و دندان اجراء گردنند. تاکید بر فواید زودرس بهداشت دهان و دندان خوب از جمله تنفس و دهان خوشبو، دندانهای تمیزو ظاهر جذاب باید موارد کلیدی برای تحریک نوجوانان برای رعایت و حفظ بهداشت دهان و دندان باشد. در این مداخلات باید به پسران و دانش آموزانی که وضعیت اقتصادی، اجتماعی پایین تری دارنند توجه بیشتری شود.

آدرس نویسنده:
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List of original publications

The present thesis is based on the following original publications, which will be referred to in the text by their Roman numerals.

I. Yazdani R, Vehkalahti MM, Nouri M, Murtomaa H. Oral health and treatment needs among 15-year-olds in Tehran, Iran. Community Dental Health 2008; 4: 221-225.

II. Yazdani R, Vehkalahti MM, Nouri M, Murtomaa H. Smoking, tooth-brushing and oral cleanliness among 15-year-olds in Tehran, Iran. Oral Health and Preventive Dentistry 2008; 1: 45-51.

III. Yazdani R, Vehkalahti MM, Nouri M, Murtomaa H. Validity of self-assessment of oral health among 15-year-olds in Tehran, Iran. Oral Health and Preventive Dentistry 2008; 4: 263-269.

IV. Yazdani R, Vehkalahti MM, Nouri M, Murtomaa H. School-based education to improve oral cleanliness and gingival health in adolescents in Tehran, Iran. International Journal of Paediatric Dentistry 2009; 19: xx-xx (In print).

Abbreviations

AAPD	American Academy of Pediatric Dentistry
ANOVA	One way Analysis Of Variance
ARR	Absolute Risk Reduction
BI	Bleeding on probing
CI	Confidence interval
CPI	Community periodontal index
DMFT	Number of decayed, missing, and filled permanent teeth
DT	Number of decayed permanent teeth
FT	Number of filled permanent teeth
HOET	Tehran's Head Office for Education
ICS II	Second International Collaborative Study
IOTN	Index of orthodontic treatment needs
MT	Number of missing permanent teeth
NIH	National Institute of Health
NNT	Number needed to treat
NPV	Negative predictive value
OR	Odds ratio
PI	Plaque index
PPV	Positive predictive value
SD	Standard deviation
SiC	Significant Caries Index
Sn	Sensitivity
Sp	Specificity
WHO	World Health Organization

In this study, tooth numbers follow the ISO / FDI / WHO approved system, e.g., 26 = upper left second molar.

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1. Introduction

Oral health problems remain a global problem and therefore require global concern (Greenspan, 2007). Despite great improvement in the oral health of populations globally, problems still persist, particularly among underprivileged groups, both in developed, and developing countries (Petersen, 2003). Oral diseases are highly prevalent, and their impact on both society and the individual are significant: pain, disability, and handicap due to oral diseases are common (Sheiham and Watt, 2003). Poor oral health may have a profound effect on general health, and several oral diseases are related to chronic diseases (Ylöstalo et al., 2006; Bazile et al., 2002). The experience of pain, problems with eating, chewing, smiling, and communication due to missing, discolored or damaged teeth have a major impact on people's daily lives, and well-being. Furthermore, oral diseases can restrict people's activities at school, at work, and at home, causing millions of lost school and work hours each year throughout the world (Petersen et al., 2005). The causes of dental diseases are known, and the conditions are largely preventable (Fejerskov and Kidd, 2003; Murray et al., 2003). The significant role of socio-behavioural and environmental factors in oral disease and health has been demonstrated in earlier studies (Petersen, 2003; Sheiham and Watt, 2000).

One-fifth of the world's population is adolescent. A young person with high self-esteem and good social skills who is clear about her/his values and has access to relevant information is likely to make positive decisions about health (Petersen, 2003). During adolescence, young people are able to assume responsibility for learning and maintaining health-related attitudes and behaviours that carry over into adulthood (Honkala et al., 2002; Åstrom and Samdal, 2001). Such learning can lead to stable patterns of physical activity, positive dietary habits, and the avoidance of smoking (Singer et al., 1995; Kelder et al., 1994). Among adolescents, age 15 is recommended age-group for the assessment of oral health status (WHO, 1997).

The school system is the logical environment in which to teach preventive dental health practices (Flanders, 1987). The school can provide a supportive environment and an ideal setting for promoting oral health (WHO, 2003b; U.S. Surgeon General's Report, 2000). In Iran, most adolescents attend high school, thus offering easy access to and high coverage for school-based activities.

Oral health education is an important part of oral health promotion and has been considered an essential and basic part of dental health services (Blinkhorn, 1998). Oral health education aims to promote oral health through educational means, principally the provision of information to improve oral health knowledge and awareness for adoption of a healthier lifestyle, changed attitudes, and desirable behaviours (Murray et al., 2003; Kay and Locker, 1996). Oral health education is essential for promoting oral health in adolescents (Östberg, 2005; Biesbrock et al., 2003).

Iran covers an area of 1.6 million km^2. The population of the country is about 70 million. The country is divided into 30 provinces, with approximately 67% of the population living in urban areas. Approximately 52% of the population is under age 20, making Iran one of the youngest countries in the world. Public education in Iran lasts for 12 years: 5 years of primary, 3 years of secondary, and 4 years of high school. The age for starting primary school is 7 and for high school, 15 (Pakshir, 2004; Iran Statistical Year Book, 2002).

In Iran, the general level of oral health is unsatisfactory, particularly among school children (Oral Health Situation of Iranian Children, 2000). Poor oral hygiene and gingival status characterize the dental health condition of Iranian adolescents (Pakshir, 2004), similar to the situation in many developing countries (Petersen, 2003).

In Iran, a national oral health promotion programme for children aged 6 to 12 years was initiated by the Department of Oral Health, Ministry of Health, in 1997. Oral health education for children and their parents involved school health technicians and volunteer teachers supervising tooth-brushing including weekly use of 0.2% sodium fluoride mouth-rinse in the schools. In addition, low-cost facilities for basic curative and preventive treatments have been the components of this national programme, a programme implemented only for primary schools (Samadzadeh et al., 2000).

The present study focused on dental health assessment of 15-year-olds and also evaluated the impacts of a school-based educational intervention on their oral cleanliness and gingival health, with the ultimate objective of improving the oral hygiene and dental health of the adolescents.

2. Literature review

2.1. Dental health

Dental health is integral to general health, essential for well-being and significantly impacting on quality of life (WHO, 2003a, b). Dental diseases are very prevalent, and their impact on the individual and community are significant (Petersen, 2003). Dental caries, periodontal diseases, and malocclusion can be significant dental problems during adolescence (AAPD, 2008). According to the common risk factor approach poor oral hygiene, poor diet (sugar consumption), and smoking are major risk factors not only for dental health but also for general health (Sheiham and Watt, 2000). In Iran, poor oral hygiene level, high rates of untreated caries (Pakshir, 2000), and rising rate of smoking (Sarrafzadegan et al., 2004) among adolescents indicate an increasing need for health promotion.

2.1.1. Dental caries

Prevalence of dental caries

Dental caries is one of the most prevalent chronic diseases worldwide; it is the primary cause of oral pain and tooth loss. Individuals are susceptible to this disease throughout their lifetime (Selwitz et al., 2007). Dental caries is still the main oral health problem in most industrialized countries, affecting 60 to 90% of school-aged children and the vast majority of adults (WHO, 2003a). It is also the most prevalent oral disease in several Asian and Latin American countries, but it appears to be less common and less severe in most African countries (WHO, 2003a). According to the Surgeon General's report, dental caries continues to be the most common infectious disease in of childhood (U.S. Surgeon General's Report, 2000).

The recommended diagnostic threshold of dental caries for epidemiological surveys is dentinal caries (WHO, 1997). The most common index for measuring dental caries in the permanent dentition is the DMF index. This is based on the presence of dentinal caries, including the current untreated decay (DT) plus evidence of past disease, such as teeth being filled (FT) or missing (MT) due to caries.

Table 2.1 shows percentages of 15-year-olds affected by caries from each of the six WHO administrative regions from 1995 to 2005. Among these regions, the mean number of DMFT was lowest for the Africa Region and highest for the Eastern Mediterranean Region. Nationwide surveys in Iran indicate a mean DMFT of 2.4 for 12-year-olds, and 5.0 for 15- to 19-year-olds in 1990-1992, and 1.5 for 12-year-olds in 1998 (Pakshir, 2004; Samadzadeh et al., 2000). Based on the results of recent survey in 2001-2002 in Iran, the mean number of DMFT for 15-19 years was 4.1 which comprised DT=2.7, MT=0.7, and FT=0.6 (Pakshir, 2004).

The corresponding figures for caries data among Finnish 15-year-olds based on the most recent report are: caries-free (DT=0) 35% in 1994, and 38% in 2000; DMFT mean 2.8 in 1994, and 2.6 in 2000 (Nordblad et al., 2004).

It should be emphasised that dental caries as a disease of children has not been eradicated, but only to some degree controlled (Petersen et al., 2005). Current research suggests that dental caries is declining in all ages, yet remains highest during adolescence (Kaste et al., 1996). Dental caries in adolescents often are confined to developmental pits and fissures (Burt, 1998).

Table 2.1. Percentage of 15-year-olds affected by caries, based on data from World Health Organization (WHO) regions, 1995-2005 (http://www.whocollab.od.mah.se/index.html).

WHO region and country	Year surveyed	DT>0 (%)	DMFT (Mean)
Africa			
Gambia	1995	73	2.8
Nigeria	2002	n.a.	0.6
South Africa	1999-2002	51	1.9
Zimbabwe	1995	43.0	n.a.
Americas			
Barbados	2001	45	1.5
Costa Rica	1999	83	4.4
Haiti	1999	46	1.4
Eastern Mediterranean			
Bahrain	1995	n.a.	2.5
Lebanon	2000	90	5.4
Morocco	1999	82.5	4.3
Oman	1996	73.2	3.2
Pakistan	2003	n.a.	1.9
Syria	1998	n.a.	3.6
Europe			
Belarus	1995	92	4.7
Czech Republic	1998	90	5.0
Denmark	2005	57.3	1.8
Germany	2005	53	1.8
Ireland	2002	74	3.2
Lithuania	2001	n.a.	5.1
Slovenia	1998	81.0	4.3
Switzerland	2000	n.a.	1.6
Uzbekistan	1996	68.3	1.9
Southeast Asia			
Indonesia	1995	89.38	2.4
Sri Lanka	1995	69.7	2.5
Thailand	2000-01	62.1	2.1
Western Pacific			
Australia	2000	55.1	1.9
China	1995-96	52.43	1.4
Viet Nam	2001	67.6	2.2

In many developing countries, if treatment were available, the costs of dental caries alone in children would exceed the total health care budget for children (Yee and Sheiham, 2002). Moreover, traditional treatment of oral diseases is extremely costly; they are the fourth most expensive diseases to treat in most industrialized countries (Petersen, 2004).

Risk factors for dental caries

Dental caries can vary with time since many risk factors evolve. Physical and biological risk factors include inadequate salivary flow and composition, high numbers of cariogenic bacteria, insufficient fluoride exposure, immunological components, and genetic factors (Selwitz et al., 2007; Fejerskov and Kidd, 2003). Caries is related to one's lifestyle, and behavioural factors are involved (Chen et al., 1997). These factors include poor oral hygiene and poor dietary habits such as high sugary foods and snacks consumption (Fejerskov and Kidd, 2003; Murray, 2003). Other risk factors related to caries include poverty, deprivation,

and socio-economic status (Dugmore and Rock, 2005; Hobdell et al., 2003). Moreover, children with a history or evidence of caries should be regarded as being at increased risk for future caries (Selwitz et al., 2007; Fejerskov and Kidd, 2003). In general, among adolescents, the most reliable predictor of future caries has been their caries experience (Vehkalahti et al., 1996; Alaluusua et al., 1990).

Treatment of dental caries

Before the 19th century, dental treatment was restricted to extraction of teeth and use of traditional remedies. In late the 19th century, with increased knowledge of the aetiology and management of dental caries, the restoration era began. The main focus of dentistry during this era was to conserve the teeth by various restoration techniques (Ismail et al., 2001). Experience in many developed countries has shown that the oral health of the population could not be improved merely by applying the restorative approach (Anusavice, 2005). Over the past decades there has developed a transition in many countries towards a largely preventive and preservative approach to caries management (König, 2004; Ismail et al., 2001).

Prevention of dental caries

A number of community and individual level strategies for preventing caries have been evident during the last three decades (NIH, 2001). For oral self-care, fluoride toothpaste is one of the most powerful interventions for caries prevention, due to its clinical effectiveness, and social acceptability. This conclusion is supported by a current Cochrane review (Marinho et al., 2003a). The effectiveness of fluoride gels, fluoride varnish, and pit-and-fissure sealant for inhibiting dental caries among children and adolescents have also been shown by Cochrane reviews (Ahovuo-Saloranta et al., 2004; Marinho et al., 2003b; Marinho et al., 2002).

Effective caries prevention programmes can use a range of interventions including community fluoridation of water or of salt, school water fluoridation, school mouth-rinse programmes, provision of fluoride tablets at school, and school dental sealant programmes (Selwitz et al., 2007).

Prevention and control of dental caries can be promoted among schoolchildren by auxiliary personnel other than dental professionals (Axelsson and Lindhe, 1976) if such personnel are appropriately trained, especially in a country with a low dentist-population (1:5,500) ratio such as Iran (Pakshir, 2004). Students can be examined by auxiliary personnel for signs of early carious condition and for preventive treatment.

2.1.2. Periodontal diseases

Periodontal diseases often affect children and adolescents. These diseases include gingivitis, localized or generalized aggressive periodontitis (juvenile periodontitis and prepubertal periodontitis) and periodontal diseases associated with systemic disorder (Oh et al., 2002).

Globally, most children and adolescents show signs of gingivitis (Petersen and Ogawa, 2005). Adolescence is an important period in a human being's periodontal status. At puberty the periodontium undergoes changes and inflammation rises, this is usually manageable through oral hygiene and regular dental care (Löe, 2000; U.S. Surgeon General's Report, 2000).

The WHO recommends use of Community Periodontal Index (CPI) as an epidemiologic tool to increase international uniformity of epidemiological studies on periodontology. Based on the recommendation by the WHO (1997), the CPI index with three scores (0=healthy gum, 1=gingival bleeding, 2=calculus) can serve for evaluation of the periodontal status of 15-year-olds. According to CPI scores, calculus, and gingival bleeding are common findings among 15-year-olds in the six WHO regions (http://www.whocollab.od.mah.se/index.html) (Figure 2.1). According to the highest CPI scores among Iranian adolescents, 8% had healthy gingiva, 23% had bleeding, and 48% calculus (Hessari et al., 2008).

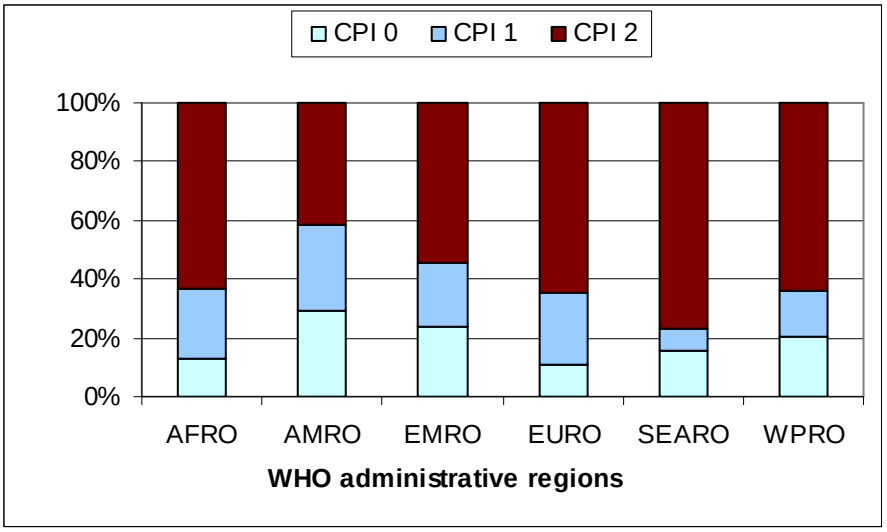

Figure 2.1. Mean percentages of maximal CPI scores in 15-year-olds by WHO Regions. AFRO: Africa, AMRO: Americas, EMRO: Eastern Mediterranean, EURO: Europe, SEARO: South-East Asia, WPRO: Western Pacific.

Risk factors for periodontal diseases

Oral hygiene level

The role of plaque as the principal aetiological factor in the development of periodontal diseases has been revealed by several studies (Albandar, 2002; Löe, 2000). Oral hygiene reflects the amount of plaque on teeth, and it is reasonable to predict that the level of oral hygiene in a population is positively correlated with the prevalence and severity of periodontal diseases (Albandar, 2002; Löe, 2000). Adolescence can be a time of heightened periodontal diseases due to inattention to oral hygiene procedures (Macgregor et al., 1996).

Smoking

The adverse effects of smoking on the general health of populations have been well established (U.S. Surgeon General's Report, 2000). Smoking is a global problem among adolescents and young adults (Petersen, 2003; Machay and Eriksen, 2002). The effects of smoking have been studied broadly during the past several years, and the body of evidence suggests a very strong relationship between different types intensity of smoking habits and

gingival status, periodontal tissue loss, and severity of periodontitis (Millar and Locker, 2007; Albandar, 2002; Johnson and Bain, 2000).

Diabetes mellitus

Diabetes mellitus is an important risk factor for periodontal diseases (Albandar, 2002; Page and Beck, 1997). Individuals with uncontrolled or poorly controlled diabetes are at risk for more severe periodontitis than are those with controlled diabetes and nondiabetic individuals. Periodontal therapy aims to improve periodontal condition and improve metabolic control of the diabetes (Aldridge et al., 1996). The risk for severe periodontitis for well-controlled diabetics, particularly those without calculus and with good dental care and oral hygiene is no greater than for nondiabetic individuals (Page and Beck, 1997).

Age

It has been generally claimed that increasing age is a risk for periodontitis and that aged persons are more at risk than younger persons for periodontal diseases. Evidence shows that manifestations of periodontitis are more severe in older than in younger individuals. These results indicate that age is a good indicator of the amount of periodontal tissue loss that occurs due to periodontal diseases (Albandar, 2002; Albandar et al., 1999). Among children and adolescents, prevalence of periodontal diseases tends to increase with age (Jenkins and Papapanou, 2001).

Gender

Studies have consistently shown that periodontal diseases are more prevalent in boys than in girls (Timmerman and van der Weijden, 2006; Jenkins and Papapanou, 2001). Poorer oral hygiene level and hormonal and other physiological and behavioural differences between the genders may also contribute to this higher risk for periodontal diseases (Albandar, 2002).

Other risk factors for periodontal diseases

Race ethnicity, genetic factors, host-response factors, socioeconomic status, osteoporosis, and stress, are among other risk factors for periodontal diseases. These different risk factors show periodontal disease to be a multifactorial disorder. Microbial dental plaque is the principal aetiological factor of periodontal disease, but several other local and systemic factors also have important modifying roles in its pathogenesis. (Pihlstrom et al., 2005; Albandar, 2002; Page and Beck, 1997).

Prevention of periodontal diseases

The best approach to managing periodontal diseases is prevention, followed by early detection and treatment (Oh et al., 2002). Prevention of gingivitis and periodontitis is based on control of their causal and risk factors. The most widely accepted risk factor is dental plaque that forms on the teeth because of the lack of effective oral hygiene (Pihlstrom et al., 2005; Löe, 2000; Page and Beck, 1997). However, various factors such as smoking, diabetes, ethnic origin, poor education, infrequent dental attendance, genetic effects, increased age, male sex, and stress are important considerations in the prevention of periodontal diseases (Albandar, 2002; Pihlstrom, 2001).

Based on the WHO recommendation (Petersen et al., 2005) and common risk factors approach (Sheiham and Watt, 2000), improvements in periodontal health may be achieved by countries along with better control of diseases such as diabetes, and intervention in relation to tobacco use, alcohol consumption, and unhealthy diet. According to the WHO approach, public health authorities should ensure, therefore, that prevention of periodontal

disease is an integral part of the prevention of chronic diseases, as well as of health promotion (Petersen, 2003).

The adolescent may be subjected to acute conditions such as acute necrotizing ulcerative gingivitis, periodontitis, and traumatic injuries, which can require immediate or occasional long-term management. In most of these conditions, early diagnosis, treatment, and appropriate management can, however, prevent irreversible damage (Grossi et al., 1995).

Dental self-care practices in childhood are associated with periodontal diseases in adulthood, and good oral hygiene behaviour in adolescence lesser the periodontal problems during adulthood (Lissau et al., 1990). For these reasons, adolescents should be educated and motivated to maintain personal oral hygiene through daily plaque removal, including flossing, with its frequency, and pattern based on the individual's disease pattern and oral hygiene needs (AAPD, 2004). Professional removal of plaque and calculus is recommended highly for the adolescent, with the frequency of such intervention based on the individual's assessed risk for periodontal/caries diseases (Burt and Eklund, 2005; Kallio, 2001).

2.1.3. Orthodontic treatment needs

Within the area of occlusal problems are several tooth-/jaw-related discrepancies which can affect the adolescent. Third-molar malposition and temporomadibular disorders require special attention to avoid long-term problems. Congenitally missing teeth may present complex problems for the adolescent and often require combined orthodontic and restorative care for acceptable treatment (AAPD, 2008). Malocclusion is not a disease but rather a set of dental deviations which in some cases can influence quality of life (Petersen, 2003). Malocclusion can be a significant treatment need in the adolescent population with both environmental and genetic causes. Estimates of different traits of malocclusion are available from a number of countries, primarily in North America and northern Europe. In ICS II countries, dento-facial anomalies occur in about 10% of the adolescents (Chen et al., 1997). Based on a recent study in Iran among 12- to 15-year-olds, 70% of the pupils had normal occlusion or minor malocclusion, indicating no need for orthodontic treatment, and only 4% had definite orthodontic treatment needs (Danaei et al., 2007).

Adolescents' malocclusion problems may lead to difficult treatment decisions. The malocclusion heavily influences how the problem will be managed (AAPD, 2008). "If the malocclusion is skeletal, treatment is aimed at altering the relationship or orientation of the jaws and teeth which can be accomplished by growth modification, camouflage, and orthognathic surgery" (Proffit et al., 2007). However, losing permanent teeth to decay or trauma and losing primary teeth with no successors, means a combination of orthodontic tooth movement and restorative dentistry is suggested to obtain the optimal aesthetic and functional result among adolescents (Pinkham et al., 2005).

The effective organizing and planning of orthodontic services within a public health system requires accurate data on the orthodontic treatment needs of the child population and is essential in assessing the resources required (Chestnutt et al., 2006). Recently, occlusal indices have been developed to categorize the treatment of malocclusion into groups according to urgency and need for treatment (Otuyemi and Jones, 1995). The Index of Orthodontic Treatment Need (IOTN) has been developed to rank malocclusion on the basis of the various occlusal characters for dental health and aesthetic components (Brook and Shaw, 1989; Evans and Shaw, 1987). The validity and reliability of the IOTN have been established (Younis et al., 1997; Richmond et al., 1995). The index has also been modified to

ensure greater reliability, especially when used by non-specialists in oral health surveys (Burden et al., 2001).

2.2. Self-assessment of dental health

Dental health can be assessed with two different methods: clinical examination by a dental professional and by the person her- or himself. These two methods of assessment can be addressed as objective and subjective, respectively (Östberg et al., 2003; Locker, 1988). A variety of terms for the subjective evaluation or self-rating of dental health have been used such as self-reported, self-assessed, and self-perceived. The concepts of these terms represent are close to each other in meaning (Östberg et al., 2001; Gilbert and Nuttall, 1999; Kallio, 1996). The availability of valid self-reported measures of dental health diseases would offer an easier, low-resource, and low-cost method of obtaining data for research (Blicher et al., 2005). Self-assessment can also serve as a motivational tool for good oral hygiene, which can prove useful for community studies (Buhlin et al., 2002; Robinson et al., 1998; Kallio, 1996). In general, potential applications of subjective dental health indicators are political, theoretical, and practical (Locker, 1996). The stage of adolescence when young people mould much of their attitudes and behaviours is a focus of attention. The time trends, both in society and in oral diseases, show a need to determine how the young people perceive their dental health (Östberg et al., 2001).

The results of comparing self-perceived dental health and clinical findings have shown various degrees of usefulness, and are more useful for ascertaining the number of teeth, fillings and root canal therapy (Pitiphat et al., 2002; Palmqvist et al., 1991; Könönen et al., 1986) while less useful for identifying individual dental caries, periodontal status and gingival bleeding (Goodman et al., 2004; Östberg et al., 2003; Kallio, 1996). Questionnaires are less reliable for specific periodontal aspects, but can still be developed into a valuable tool in epidemiological studies on periodontal health (Buhlin et al., 2002). Self-assessment of bleeding could be a useful means for monitoring gingival health and increasing periodontal awareness of populations (Kallio, 1996).

Most adolescents undergo orthodontic treatment to improve their dental appearance, certainly, their major concerns are usually related to aesthetics (Burden and Pine, 1995). In relation to aesthetics it has been shown that, from the patient’s point of view, teeth are second in importance to facial appearance (Lew, 1993). A number of studies have recommended that children have developed a perceptual awareness of orthodontic treatment need (Roberts et al., 1989; Tulloch et al., 1984). Objective findings of the need for orthodontic treatment are usually more than the subject perceives (Chestnutt et al., 2006). Gender and socio-economic background are also thought to play a role in the self-perception of malocclusion, with females and higher social class individuals considered to be more critical of their dental appearance (Shaw et al., 1991; Jenkins et al., 1984). Social and individual expectations for girls and boys are different, and girls tend to exhibit more self-evaluation concerns than do the boys (Östberg et al., 2001). The importance of self-perceptions concerning orthodontics treatment cannot be underestimated, because demand of patients falls mainly on the desire for orthodontic treatment than on the need for it (Mandall et al., 2001; Yeh et al., 2000).

However, simple detection of clinical needs may not be useful for predicting demand or manpower planning. Adding self-perception to clinical assessments would likely provide a more comprehensive basis for the allocation of health resources, the monitoring of oral health, research, public health, and clinical practice (Östberg et al., 2003; Locker, 1996).

2.3. Health behaviours

The most common oral diseases: dental caries and periodontal disease could well be seen as behavioural diseases, because oral health behaviours are essential for their control. Forty years of experimental studies, clinical trials, and demonstration projects in various countries and settings have shown that effective removal of dental plaque is essential to dental and periodontal health through the life (Löe, 2000). Conventionally, oral health behaviour has been considered to consist of continuous accomplishment of those actions (e.g. dietary habits, oral hygiene, use of fluoride, and use of dental services) which have been confirmed to have a positive effect on dental health (Fejerskov and Kidd, 2003; Löe, 2000; Murray, 1999). Oral health behaviours are generally established as preventing and controlling oral diseases associated with a more or less unitary set of oral values and attitudes. These habits may be generally divided into self-care behaviours (oral hygiene, dietary habits, and use of fluorides) and behaviours of using dental services (Honkala, 1993).

2.3.1. Tooth-brushing

Effective removal of dental plaque is essential to dental and periodontal health throughout one's lifetime (Albandar and Tinoco, 2002; Löe, 2000). Dental professionals generally agree that tooth-brushing, as a mechanical measure for removing dental plaque, is the most appropriate and effective oral hygiene habit (Vehkalahti and Widström, 2004; Löe, 2000; Honkala, 1993).

A number of studies have been performed to compare the different manual brushing techniques (Agerbolm, 1991; Bergenbolz et al., 1984). It is, however, difficult to assess and compare the various brushing techniques, due to the variations in study plan and examination measures. However, no technique of tooth-brushing has been revealed to be obviously better than others, and that provided the particular brushing strokes are repeated on all accessible tooth surfaces, and if adequate time and care are used, it is possible to obtain a rational degree of cleanliness (Löe, 2000). The choice of the type of technique must be made in relation to the characteristics of the individuals such as age and periodontal status.

Numerous clinical trials have compared the effectiveness of manual and powered toothbrushes for their effectiveness in improving dental health. Recent Systematic Reviews by the Cochrane Oral Health Group (Robinson et al., 2005) have shown powered toothbrushes with an oscillating rotating action are more effective than manual toothbrushes in reducing plaque and gingivitis; other types of powered toothbrushes produce less steady reductions in plaque and gingivitis than manual brushes (Davies, 2006).

A tooth-brushing frequency of twice a day has been the commonly accepted recommendation, brushing the whole dentition after breakfast and before going to bed (Pine et al., 2000; Honkala, 1993). In Europe and North America, 18% to 86% of adolescents report twice-daily tooth-brushing, with significant gender differences, girls brushing more frequently than boys (Maes and Honkala, 2006), whereas in the Eastern Mediterranean Region, in countries such as Jordan, Saudi Arabia, and Sudan, corresponding percentages range from 33% to 62% (Darout et al., 2005; Farsi et al., 2004; Rajab et al., 2002). In Iran, 44% of Iranian 12-year-olds brush their teeth at least once daily (Oral Health Situation of Iranian Children, 2000).

Determinants of tooth-brushing

The association between socio-demographic factors and oral health, including oral health behaviour, has been investigated in many studies. Dental health habits in children and young

adolescents are associated with ethnicity and high social class, such as maternal education and parental career status (Maes and Honkala, 2006; Vanobbergen et al., 2001). Tooth-brushing is powerfully influenced by an individual's lifestyle and social behaviour (Macgregor et al., 1996) such as smoking, drinking, eating, bedtime, and watching television. Tooth-brushing is not only oral health behaviour, but is also a predictor for the future lifestyle of adolescents. Adolescents with a low tooth-brushing frequency reach only the lowest education levels, and concentrate around smoking and alcohol use (Koivusilta et al., 2003).

Motivation for tooth-brushing has earned scarce attention. Tooth-brushing frequency is strongly related to personal cleanliness and increases along with increasing frequencies of bathing, hairwashing and other hygiene practices (Macgregor and Balding, 1987). As early as in 1976 Linn reported that in one third of adolescents the most important reason for tooth-brushing was to make sure of good personal appearance; only one third were mainly concerned to keep their teeth as long as possible. The researchers found that higher percentages (60%) of 14-year-old schoolchildren reported tooth-brushing for cosmetic than for dental health reasons. In girls, the highest percentage (63%) brushed to make the teeth feel clean compared with any other motivation; in boys, the proportion who brushed mostly to make the mouth feel clean increased with higher brushing frequency (Macgregor and Balding, 1987). In adolescents, tooth-brushing frequency has been shown to increase with increasing self-esteem, and with self-esteem improvement more subjects brush their teeth to make them feel clean (Regis et al., 1994).

2.3.2. Tobacco use

Tobacco is a risk factor for periodontal diseases, oral cancer, oral cancer recurrence, and congenital defects such as cleft lip and palate. Evidence as to the aetiological relationship between smoking and caries rates is insufficient. However, a lower salivary pH and buffering capacity might be reasons for higher caries rates among smokers (Johnson and Bain, 2000). Tobacco suppresses the immune system's response to oral infection, compromises healing after oral surgery and accidental wounding, promotes periodontal degeneration in those with diabetics, and unfavourably affects the cardiovascular system (Reibel, 2003). In addition, the risks of tobacco significantly increase when it is used with alcohol. Most of the oral consequences of tobacco use such as halitosis, oral birth defects, periodontal disease, and complications during wound healing impair quality of life (Petersen, 2003; Reibel, 2003).

The prevalence of tobacco use and smoking has decreased in some high-income countries but continues to increase in low-income and middle-income countries, particularly among young people and women (Petersen, 2003; Machay and Eriksen, 2002; WHO, 2002). Certainly, the increasing number of smokers and smokeless tobacco users among young people in some parts of the world will noticeably affect the general and oral health of future generations. The prevalence of tobacco use and smoking in most countries is highest among people of low educational background and among poor people. Tobacco use is a major preventable cause of premature death and of several systemic diseases (Petersen, 2003). In addition, cigarette, pipe, cigar and bidi smoking, betel quid chewing (pan), and other traditional forms of tobacco have several harmful effects on oral health (Reibel, 2003; Johnson and Bain, 2000).

Smoking is a global problem among adolescents and young adults: 10% to 30% of 13- to 15-year-olds worldwide are smokers (Petersen, 2003; Machay and Eriksen, 2002). The highest youth smoking rates can be found in Central and Eastern Europe, sections of India, and some

of the Western Pacific islands (Petersen, 2003; Machay and Eriksen, 2002). In Iran, based on serum cotinine level, 13% of high school students aged 14-18 years are smokers (Sarraf-zadegan et al., 2004). Table 2.3 shows the demographics of smoking among youth in selected countries (www.who.int/entity/tobacco/en/atlas40.pdf).

Table 2.3. WHO[1] statistics on smoking among youth in selected countries.

Countries	Youth smoking			Exposed to passive smoking at home
	Total %	Male %	Female %	%
Chile	37.9	34.0	43.4	57.0
Russian Federation	35.1	40.9	29.5	55.3
Ukraine	34.6	37.7	30.8	49.0
Argentina	28.1	25.7	30.0	68.2
Bolivia	26.4	31.0	22.0	46.0
USA	25.8	27.5	24.2	42.1
Poland	24.4	29.0	20.0	67.0
South Africa	24.3	29.0	20.8	43.6
Uruguay	23.9	22.0	24.0	-
Philippines	23.3	31.2	17.2	58.2
Indonesia	22.0	38.0	5.3	63.0
Mexico	21.7	27.9	16.0	45.5
Costa Rica	20.8	20.6	21.0	32.8
Haiti	20.7	21.0	20.0	31.3
Jordan	20.6	27.0	13.4	67.4
Peru	19.5	22.0	15.0	29.0
Jamaica	19.3	24.4	14.5	-
Cuba	19.2	18.0	20.0	68.9
Zimbabwe	18.3	19.0	17.0	35.6
Nigeria	18.1	22.0	16.0	34.3
Ghana	16.8	16.2	17.3	22.2
Venezuela	14.8	15.3	13.9	43.5
Kenya	13.0	16.0	10.0	-
China	10.8	14.0	7.0	53.0
Sri Lanka	9.9	13.7	5.8	-
Singapore	9.1	10.5	7.5	35.1
Nepal	7.8	12.0	6.0	-

[1]Available at www.who.int/entity/tobacco/en/atlas40.pdf

Smoking and use of smokeless tobacco almost always are initiated and established in adolescence (Machay and Eriksen, 2002). One third of all smokers have had their first cigarette by age 14, and 28% of high school students report using some type of tobacco (AAPD, 2008). The earlier that children and adolescents begin using tobacco, the more likely that they will become highly addicted and continue using as adults. If current tobacco use patterns continue in the United States, an estimated 6.4 million persons now under the age of 18 will die prematurely from a tobacco-related illness (AAPD, 2008).

In 39 countries in Europe, Canada and the USA, youth age 15 smoked at least once a week at percentages ranging from 8% to 43% (Figure 2.2).

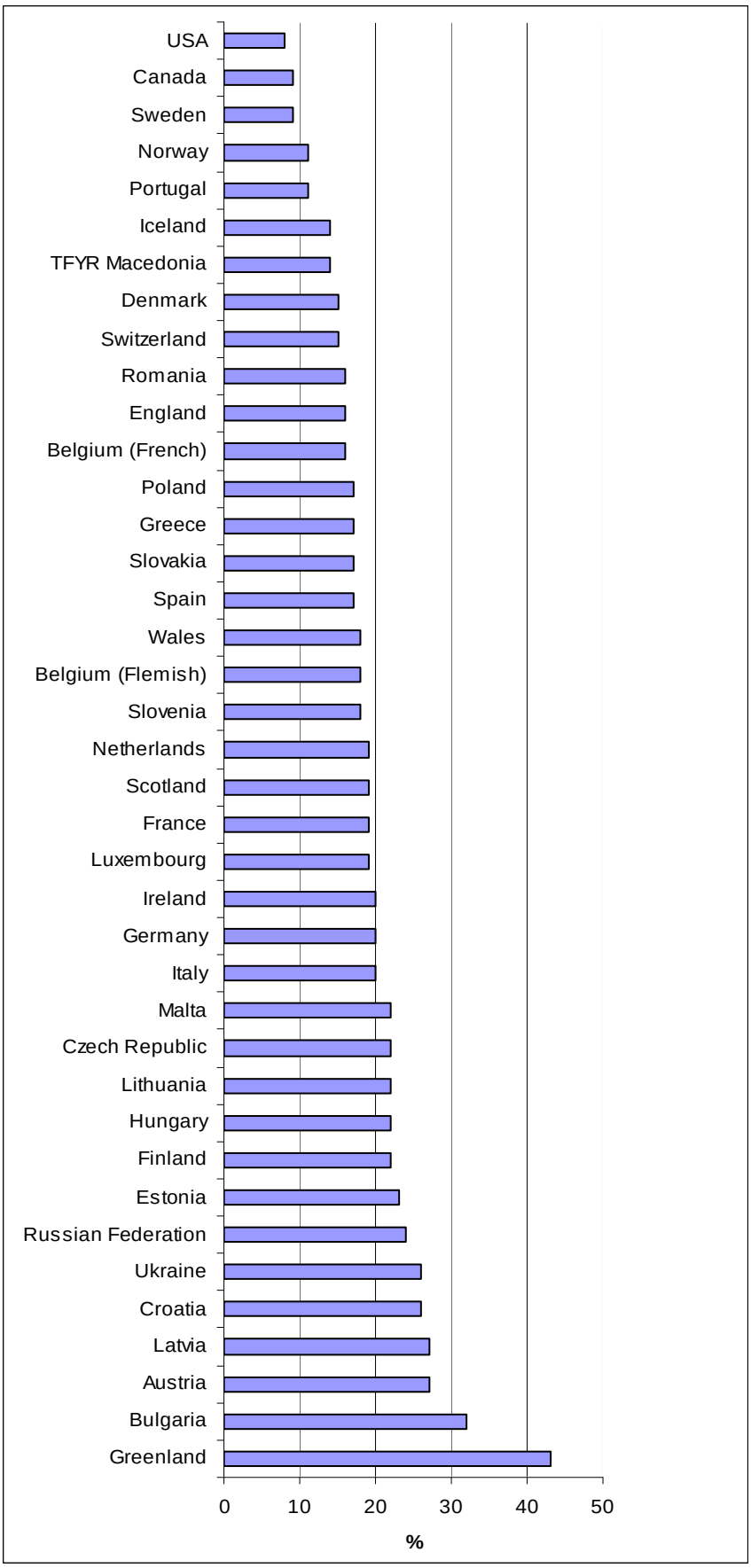

Figure 2.2. Percentages of 15-year-olds smoking at least once a week in Europe, Canada and the USA (WHO, 2008).

2.4. Dental health education

"Dental health education is a planned package of information, learning activities, or experiences that are intended to promote dental health" (Overton Dickinson, 2005). To benefit from the many preventive measures that exist, all need to be aware of them and know how to use them appropriately. This level of knowledge is known to be a necessary and be one of the key determinants of behaviour change (Blinkhorn, 1998). Oral health education affects the individual's oral health literacy that is imperative for better oral health. Oral health literacy emphasizes the availability of skills to obtain, understand and use information for appropriate oral health decisions (Horowitz and Kleinman, 2008). Improving the use ability of health information, education and paperwork is essential for better oral health. Using plain language in the educational material such as a leaflet can help users find the information they need, understand it, and act appropriately on that understanding (Horowitz and Kleinman, 2008). Self-directed educational material such as a leaflet is an inexpensive and practical way of targeting large sections of the population to usage them to consider health change (Adair and Ashcroft, 2007).

A number of systematic reviews have been conducted on the effectiveness of oral health education (Kay and Locker 1998, 1996), revealing its effectiveness in increasing knowledge and proper behaviour such as tooth-brushing, in the short term. The cost-effectiveness of oral health education has proved to be inconclusive, due to the limited high-quality evidence (Kay and Locker 1996). However, oral health education remains the ethical responsibility of dental professionals to transfer knowledge about improving oral health to the public (Blinkhorn, 1998).

Theories and models derived from increasing knowledge in sociology, education, and psychology can describe the learning process and behavioural change in individuals (Søgaard, 1993) that can be applied to adolescents, as well.

Theories and models of behavioural changes have been categorized historically into three stages (Inglehart and Tedesco, 1995): (1) Behaviour-centered learning theories (1920s-1940s), (2) General cognitive theories (1940s-1960s) and (3) Specific social-cognitive theories (from 1960) with five approaches (self-efficacy, health belief model, theory of reasoned action, theory of planned action, and relapse prevention model). All models in stage 3 have something to offer, but they clearly do not cover all aspects of complicated issues in health behaviour changes. For this reason, three strategies for behavioural-changes studies exist for using the models (Inglehart and Tedesco, 1995). Strategy 1 is the single-model strategy: In this strategy researchers choose one of the five models in stage 3 and continue to explore its relative effectiveness (McCaul et al., 1992). A second strategy, the multi-model strategy, tries to choose components from several of the five models in stage 3 to increase the degree of explained behaviour change variance (Tedesco et al., 1991). The third strategy is the New Century model of oral health promotion. It aims at understanding oral health promotion in its whole complexity and at suggesting simple and useful clinical interventions. It attempts to do justice to the complexity of this issue by building on the knowledge base available so far and by including aspects that have been neglected. The model shows oral health promotion is a function of oral health-related affect, behaviour and cognition, time and situation (Inglehart and Tedesco, 1995).

No single theory or model is appropriate as a guide in designing health education interventions. In this case, it may be more useful to choose several theoretical perspectives or parts of models (Adair and Ashcroft, 2007).

The second International Collaborative Study (ICS II) Model is based on some different theoretical aspects that tries to explain oral health behaviours in their whole complexity. (Chen et al., 1997). This model presents relationships among factors associated with oral health behaviours, oral health status and oral health outcomes. This model explains that an individual's oral health behaviours, as the intermediate outcome, is affected by predisposing and enabling characteristics. Furthermore, these personal characteristics are influenced by the system-level factors, socio-environmental characteristics and the oral health care system. The model also assumes that the individual's personal characteristics and oral health behaviours affect their oral health status, measured mainly as dental and periodontal status.

2.4.1. School-based dental health education

Dental health education can take place in a wide variety of settings: primary care, clinics, schools, pre-school education and care, local authority services, commercial organizations, the workplace, community-based initiatives and older people's residential homes (Overton Dickinson, 2005). The school provides a perfect setting for promoting oral health. Schools offer an efficient and effective way to reach over 1 billion children worldwide and, through them, families and community members (WHO, 2003b). Schools can be an important setting for health education programmes (Pine, 2007). Many advocacies promote oral health through schools. The school system is the logical environment in which to teach preventive dental health practices (Flanders, 1987). The rationale behind the inclusion of educational activities is that prevention is the key element in controlling dental disease. School-based oral health education in the short term has shown positive outcomes for oral cleanliness, gingival health and oral health knowledge in some developing (Petersen et al., 2004; Sri Wendari et al., 2002; Buischi et al., 1994) and developed countries (Chapman et al., 2006; Biesbrock et al., 2003).

The educational interventions vary noticeably, from the simple provision of information to the use of complex programmes relating to psychological and behaviour-altering strategies. In school-based oral health education, simple approaches are usually as effective as more complex interventions for improving oral hygiene (Kay and Locker, 1998). The objectives of the interventions have also been broad, so that knowledge, attitudes, beliefs, behaviours, dental services utilization, and oral health hygiene have all been noticed as leading to improvement (Kay and Locker, 1996; Honkala, 1993).

Adolescents have distinctive needs due to their: (1) potentially high caries rate, (2) increased risk for periodontal diseases, (3) tendency toward poor nutritional habits, (4) increased aesthetic desire and awareness, (5) complexity of combined orthodontic and restorative care, (6) initiation of tobacco use and smoking, and (7) eating disorders (AAPD, 2008; Pinkham et al., 2005). These distinctive needs therefore call for oral health promotion programmes for controlling and preventing oral health problems among adolescents.

External factors have a tremendous impact on how adolescents behave and think; the values and behaviours of their peers are increasingly important, although parents and other family members continue to be influential. Programmes aimed at improving the oral health of youth needs to take these factors into account, for example in relation to consumption of sweets snacks, sugary beverages, tobacco, and alcohol. An active alliance between home, schools, oral health professionals, and community organizations are necessary in order to control risks to oral health in young people (Petersen, 2003).

2.4.2. Educational messages in dental health

In dental health education, it is suggested that advice should be based on the following messages (Chapman et al., 2006, Petersen et al., 2004; Murray, 1999):

- Reduce the use and particularly the frequency of intake of sugar-containing food and drink.

The frequency of sugar-containing food and drink is the most important factor in the progress of dental caries. Snacks and drinks ought to be free from sugars. Frequent use of acidic drinks should be avoided (Murray et al., 2003; Burt and Pai, 2001).

- Brush the teeth carefully every day with fluoride toothpaste.

Elimination of dental plaque is necessary for the prevention of periodontal disease. Regular tooth-brushing by itself will not prevent dental caries, but a specific advantage will be gained by the use of fluoridated toothpaste (AAPD, 2008; Löe, 2000). Water fluoridation, use of fluoridated toothpaste, and other fluoride products are recommended for caries prevention (Selwitz et al., 2007; Marinho et al., 2003a, 2003b, 2002).

- Visit a dentist regularly.

Once decay is recognized and a cavity is present, the tooth can be restored and the importance of early identification and proper treatment makes regular attendance desirable. Other disorders can occur in the mouth which may be life-threatening. For all these reasons, a regular exam is recommended for everyone so that the health of the whole mouth can be monitored and proper dental health recommendation provided (Murray, 1999). It has been reported that regular attenders have better oral health (Richards and Ameen, 2002), a higher number of functioning teeth (Sheiham et al., 1985), and experience less pain and untreated disease (Murray, 1996).

3. Aims of the study

3.1. General aim

The general aim of the present study was to assess dental health and its determinants in adolescents and to evaluate the impact of school-based educational intervention on their oral cleanliness and gingival health in a community with a young population and a developing oral health system.

3.2. Specific objectives

To achieve this aim, 15-year-old school children in Tehran, Iran, were studied and the following specific objectives were set:

1. To assess dental and gingival status and orthodontic treatment needs (I).
2. To study tooth-brushing behaviour, oral cleanliness, smoking, and their relationships (II).
3. To compare clinically determined and self-perceived findings on dental health (I, III).
4. To evaluate school-based educational intervention to improve oral cleanliness and gingival health (I, IV).

3.3. Hypotheses

Working hypotheses in this study are as follows:

a) Better dental health status and health behaviours among 15-year-olds are related to female gender and higher level of parental education.
b) 15-year-olds are able to reliably self-assess their dental disease condition.
c) School-based educational intervention can improve oral cleanliness and gingival health in 15-year-olds.

4. Material & Methods

The present study is part of a joint programme between the University of Helsinki, Finland, and Shaheed Beheshti Medical University, Iran, initiated by WHO (EMRO) in 2002.

4.1. General description of the study

The present study used cross-sectional and interventional designs. The target population comprised 15-year-olds in the public schools in Tehran, Iran. The total sample was 506 students (260 boys and 246 girls). The interventional sample comprised 417 students, 205 boys and 212 girls. Data collection in the cross-sectional part was performed by clinical examination and a self-administered structured questionnaire. Dental health status was described by the following indices: Decayed, Missing, and Filled Teeth (DMFT), the Community Periodontal Index (CPI), the Modified Orthodontic Treatment Needs index (IOTN), the Plaque Index (PI), and Bleeding on Probing (BI). The questionnaire covered background information, socio-economic status, self-perceived dental health, smoking, and tooth-brushing behaviour. The intervention exposed students to dental health education through a leaflet and a videotape designed for the present study. Improvement in oral cleanliness and gingival health 12 weeks after the baseline examination demonstrated the outcome.

4.2. Conceptual framework of the study

The conceptual framework for this study is based on the ICS II model (Chen et al., 1997). This framework shows that an individual's oral health behaviours, as an intermediate outcome, are affected by their predisposing and enabling characteristics (Figure 4.1). According to this framework, characteristics such as health knowledge, attitudes, values, and perceptions predispose oral health behaviours. Socio-economic status and parents' education are enabling factors. This framework also states that predisposing, enabling factors and oral health behaviour have effects on oral health hygiene. Based on this framework, oral health education may affect health behaviours of students which will improve oral cleanliness and gingival heath.

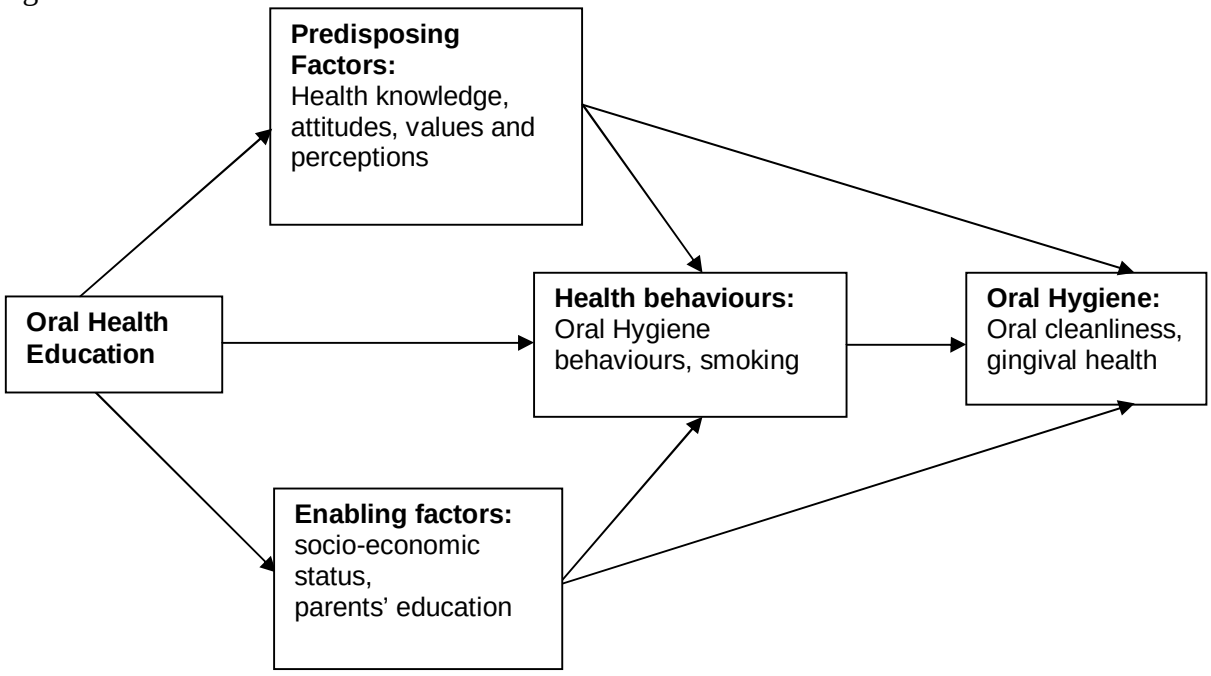

Figure 4.1. Conceptual framework of the study, modified from the ICS II theoretical model (Chen et al., 1997).

4.3. Pilot study

Prior to data collection, a pilot study was performed among 28 15-year-olds in one public school. Results from this pilot study highlighted the need for minor revisions in the questionnaire and in the clinical examination prior to their use in this study. In the pilot study, some questions were unclear to students; these were revised. In addition, for some questions, the response alternatives were expanded to comprise more possible options.

4.4. Cross-sectional part of the study

4.4.1. Study subjects and data collection

Study subjects comprised 15-year-olds in the public schools in Tehran, Iran (n=506). The sampling procedure included a random selection of 17 public schools, based on total sample size, from a list provided by the HOET. One class of 15-year-olds (grade 9) was randomly selected from each school, and all these students were invited to participate. Participation was voluntary, and all students responded to the questionnaire; only three students refused the clinical dental examination. Generally the students responded well to the all questions, and only three remained partly unanswered, each by no more than 5% of the students. The cross-sectional data were collected in January 2005.

4.4.2. Study questionnaire

The framework of the self-administered structured questionnaire was based on the Second International Collaborative Study (ICSII) (Chen et al., 1997). After a short explanation at baseline to motivate the subjects to participate, the questionnaire was distributed to the 15-year-olds for completion and returned in the class prior to the clinical dental examination (Appendix 1).

Background and socio-economic information

The students' socio-economic background was defined in three dimensions: 1) the wealth status of the family (good=living in own house, poor=living in a rented house), 2) location of the school (affluent or non-affluent, based on the HOET information), and 3) the highest level of education attained by either parent. The latter was obtained separately for father and mother by offering six alternatives, which in the analyses were categorised into three: low (illiterate, primary, or secondary school degree), medium (high school, diploma degree), and high (university degree).

Self-assessment

Self-perceived dental health was assessed in general with a single-item rating of self-perceived dental health, and as self-assessed need for a filling, gingival bleeding, and need for orthodontic treatments. The question "How would you describe your dental health?" offered six alternatives: excellent, very good, good, poor, very poor, and I do not know. For further analysis, the last one was excluded, and the other responses were dichotomized as good or better (excellent, very good, good) and poor (poor, very poor). The need for a filling was determined with the following question: If you were to go to a dentist right now for an

examination, do you think the dentist would say to you “You need fillings”? The answer alternatives were “Yes” or “No”. Self-assessed gingival bleeding was inquired with the following question: “When do you have bleeding from your gums?”; students could choose from four alternatives: “While brushing my teeth”, “While eating hard things (such as an apple)”, “Spontaneously”, and “I have not noticed bleeding from my gums”. The responses were dichotomized to “Yes” or “No” for gingival bleeding. Self-assessed need for orthodontic treatment was determined with the following question: “If you were to go to a dentist right now for an examination, do you think the dentist would say to you “Your teeth need straightening”? The answer alternatives were “Yes” or “No”.

Health behaviours

Tooth-brushing and smoking served as indicators of health behaviour. Tooth-brushing was determined with the following two questions “How often do you usually brush your teeth?” with five alternative answers: irregularly or never, once a week, a few (2-3) times a week, once a day, and more than once a day, and “When do you usually brush your teeth?” with the following alternatives, each to be answered either yes or no: in the morning, in the evening, after meals, after eating sweet snacks, and I do not brush.

Smoking status was determined with the following questions: “Do your parents or relatives living in your home smoke cigarettes?”, “Does any of your friends smoke cigarettes?”, “Do you smoke cigarettes?” with yes or no answers and “How old were you when you first tried smoking?” with six alternative answers: I have never smoked cigarettes, 7 years old or younger, 8 or 9 years old, 10 or 11 years old, 12 or 13 years old, 14 or 15 years old.

4.4.3. Clinical dental examination

Prior to the clinical dental examinations, the examiner dentist, with ten years of experience as a practicing dentist, trained for the clinical examination under the guidance of two specialized dentists (periodontist and orthodontist) during several educational and clinical sessions. A re-examination of 25 subjects was arranged, yielding 96% intra-examiner consistency for caries recordings, 88% for CPI and 96% for the IOTN. The clinical dental examination took place during school hours in the health office of the school on a comfortable chair with a headlamp, a mouth mirror and a WHO probe. Three students refused the clinical dental examination, leaving a total of 506 students in the analyses.

Dental status was recorded by tooth; findings on dental plaque, and periodontal status were recorded separately for each of the six index teeth (16, 11, 26, 36, 31, and 46). Dental health status was described by these indices: DMFT, CPI, bleeding on probing (BI), modified plaque index (PI), and modified IOTN.

Caries diagnoses followed the WHO criteria (1997). Current caries was described according to the DT index, and past caries (caries experience) according to the DMFT index. The

significant caries index (SiC) was calculated as the mean DMFT for the upper third of the subjects according to their DMFT indices (Bratthall, 2000).

The CPI scores were: 0=healthy gums, 1=gingival bleeding, 2=calculus (WHO, 1997). The original PI (Silness and Löe, 1964) was modified to include these scores: 0=no plaque, 1=plaque on the gingival margin only, 2=plaque elsewhere. The maximum of the scores for the six index teeth described a subject's periodontal status (CPI), and plaque score (PI). The BI recordings as a dichotomy on the presence or absence of bleeding followed the same criteria described for the CPI (WHO, 1997).

Furthermore, the sums of the six PI scores and of the six BI scores separately served to describe individual oral cleanliness (with a maximal PI sum of 12) and bleeding (with a maximal BI sum of 6). In addition, the sum of PI scores was later categorised as three levels of oral cleanliness: good (scores up to 4), moderate (scores from 5 to 9), and poor (scores from 10 to 12).

The Modified Index of Orthodontic Treatment Need (IOTN) has two scores: 0=no need, 1=definite need for orthodontic treatment (Burden et al., 2001). A score of 1 indicated conditions such as serious hypodontia, great and reverse overjet, supernumerary teeth, anterior and posterior cross bite, great contact point displacement, and serious lateral or posterior open bite.

4.5. Interventional part of the study

4.5.1. Sampling, randomization, blinding

Seventeen public schools participated in the baseline examination. Based on the busy schedules of their schools, three school authorities refused participation in this intervention. In each of the 14 schools co-operating, one class out of two to five classes of 15-year-olds was selected randomly. Then, 14 classes (n=417) were randomly divided into three groups: a leaflet group (five classes, n=148), a videotape group (five classes, n=139), and a control group (four classes, n=130). The study was arranged with school authorities, but students were unaware of the examination and intervention dates. Participation was voluntary, and an informed consent was acquired from each student before the study. Baseline data collection took place in January 2005 and the final examination 12 weeks later (n=388). At the follow-up examination, the examiner was blind to the study groups. Figure 4.2 shows the flow chart of the study.

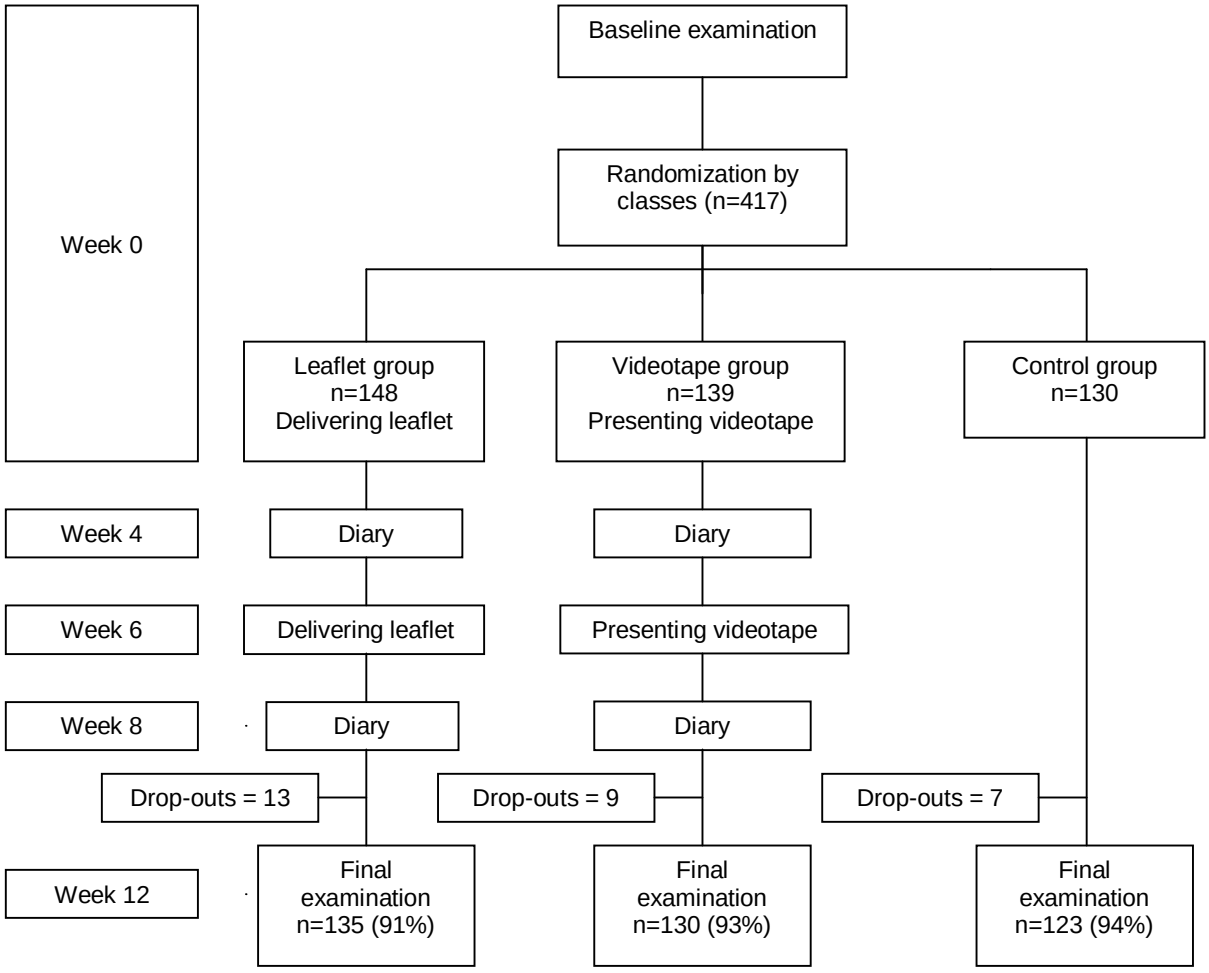

Figure 4.2. Flow chart of the school-based educational intervention on oral cleanliness and gingival health in 15-year-olds.

4.5.2. Intervention on oral cleanliness and gingival health

The intervention was based on exposing students to dental health education through a leaflet and a videotape designed for the present study. The same pictures, dental models, and script were used for producing the leaflet and videotape. Their topics were based on current concepts of recommended oral health prevention (Chapman et al., 2006; Daly et al., 2005; Petersen et al., 2004) (Table 4.1). Educational key messages were the same in both the materials: importance of oral health, role of microbial plaque, frequency and methods of proper tooth-brushing and flossing, importance of regular dental attendance, healthy diet, and proper use of fluorides. Both leaflet and videotape emphasised the immediate gains from good oral hygiene. The leaflet and videotape were designed with the assistance of communication experts. During the intervention period, trained teachers volunteered to perform all activities at the schools.

Motivation for maintaining good oral health behaviour took place twice: at week 4 and week 8 of the intervention period by means of two diaries. These diaries were designed for self-recording of student's frequencies of tooth-brushing and flossing, and of eating sweet snacks

between the main meals. Daily actions were recorded during one week. After being filled in by students, the diaries were returned to the teacher to serve for motivational purposes only.

Leaflet group. The leaflet was of pocket size with coloured pictures and illustrations for each topic to maintain the student's attention and interest. It was delivered to the leaflet group twice: at baseline and in the sixth week of the intervention period. After distributing the leaflets at baseline, about 10 minutes was allocated for students' reading it in class for the first time. This ensured that all students read the leaflet at least once.

Videotape group. The videotape was a 17-minute film shown in the classroom. It was presented twice, at baseline and in the sixth week of intervention. The motivating diaries, as in the leaflet group, were distributed to the videotape group in weeks 4 and 8.

Control group. The control group underwent the dental examination, but received no educational intervention at all.

Table 4.1. Main dental health messages included in the leaflet and videotape in a 12-week intervention to improve oral cleanliness and gingival health in 15-year-olds

Main subjects	Main messages[1]
Oral health	Healthy teeth and gums play a role in speech, chewing, mouth odour, appearance, fresh breath, aesthetics, general health and social communication. Natural teeth can be kept for a lifetime by means of perfect oral hygiene.
Dental plaque	The concept of dental plaque is vital. Daily removal of dental plaque is important.
Oral hygiene instruction	One must learn how to brush and floss the teeth.
Dental attendance	The benefit of regular dental visits: early diagnosis of oral and dental diseases, savings in money and time.
Diet	Food has consequences for oral health. Sugar consumption plays a role in dental caries and systemic diseases like diabetes and obesity.
Fluoride	The mechanisms of fluorides are vital in prevention of dental caries. Regular use of fluorides is useful. Daily use of fluoridated toothpaste is important.
The recommendations	Regular tooth-brushing, daily use of fluoridated toothpaste and dental floss are essential to dental health. Avoid and reduce use of sugary snacks and beverages especially between main meals. Have regular dental check-ups. No smoking.

[1]Based on recommendations by: Chapman et al., 2006; Daly et al., 2005; Petersen et al., 2004.

4.5.3. Evaluation of the intervention

The clinical dental examination was performed by two trained and calibrated dentists with more than 85% agreement in recording dental plaque and gingival bleeding, a dentist for the baseline examination and another dentist for the follow-up examination.

Intervention was evaluated by assessing improvements in oral cleanliness and gingival health in the intervention groups in comparison to the control group. This comparison involved mean and percentage changes in dental plaque and gingival bleeding. For each student, sums of dental plaque scores and gingival bleeding scores were calculated for both the baseline and final examinations. The sum scores of the dental plaque and gingival bleeding ranged from 0 to 12, and 0 to 6.

Improvement in oral cleanliness and gingival health was also defined as a dichotomy separately for each index tooth. Positive outcomes for oral cleanliness and gingival health per student were defined as showing improvement in at least 50% of the index teeth that had shown dental plaque or gingival bleeding at baseline. Regarding dental plaque and gingival bleeding, Number Needed to Treat (NNT) was defined separately.

For subjective assessment of the intervention, each student filled in a short, self-administered questionnaire after the final examination: To the statement "The videotape/leaflet was good material for dental health education" alternative answers were five: strongly agree, agree, disagree, strongly disagree, and do not know. For further analysis, responses with the last option were excluded (n=27), and the other responses were dichotomized as agree and disagree. The question "How much improvement in your oral health behaviour happened after watching the videotape/reading the leaflet?" offered three alternative answers: little, moderate, and very much.

4.6. Socio-demographic characteristics

Socio-demographic characteristics of 15-year-olds are shown separately in table 4.2, separately for cross-sectional and interventional parts of the study.

Table 4.2. Numbers of 15-year-olds (n=506) studied according to their socio-demographic characteristics

Socio-demographic characteristics	Cross-sectional part		Interventional part[a]	
	Boys	Girls	Boys	Girls
All	260	246	189	199
Parental education				
• High	77	86	52	68
• Medium	88	98	66	80
• Low	95	62	71	51
Wealth status of the family				
• Good	172	182	123	147
• Poor	76	61	56	51
Missing data	12	3	10	1
Location of school				
• Affluent area	149	91	111	89
• Non-affluent area	111	155	78	110

[a] students that completed the study

4.7. Ethical consideration

The present study was approved by the Ethics Committee and by the Iran Center for Dental Research at the School of Dentistry, Shaheed Beheshti University of Medical Sciences. The students gave their informed written consent to participate in the study. Participation was voluntary and an informed consent was acquired from all the students before the study. The subjects were entered into the database by a numerical code only.

4.8. Statistical methods

Data were analysed using the statistical software SPSS, Windows version 13.5. Descriptive statistics on oral health indicators included the mean, standard deviation, and confidence interval. Chi-square tests served for testing the differences between the groups according to socio-demographic background information in frequencies regarding dental findings and self-assessments, tooth-brushing, and improvement in oral cleanliness and gingival health. One-way Analysis of Variance (ANOVA) was used to test the differences in the mean scores of CPI and DMFT components between the groups according to socio-demographic background information.

Logistic regression models were fitted to the data to assess the strength of behaviours and self-assessed gingival and dental health on the associations with selected binary outcomes, controlling for socio-demographic background information. The estimates produced corresponding odds ratios (OR) and their 95% confidence intervals (95% CI). The Hosmer and Lemeshow test served for testing the goodness-of-fit of the models.

A Paired-sample t-test was used to test differences in the mean sum scores of dental plaque and gingival bleeding in the index teeth at baseline and in the final examination in each group. The independent-samples t-test was used for comparison of means of DMFT and its components according to socio-demographic information and for comparisons of improvement in mean sum scores of dental plaque and gingival bleeding between each intervention and control group.

NNT was calculated as 1/ARR (ARR=Absolute Risk Reduction) separately for dental plaque and gingival bleeding in the interventional part of study.

5. Results

5.1. Dental health status and treatment needs (I)

5.1.1 Dental status

An intact dentition (DMFT=0) was found in 40% of the 15-year-olds (44% of the boys and 37% of the girls; P=0.045, Chi-square test). Regarding dental caries, DT=0 was found in 60% of students. The mean number of DMFT was 2.1 (95% CI, 1.9, 2.4), which comprised DT=0.9, MT=0.2, and FT=1.0. No gender differences appeared in these figures. The mean SiC index was 5.2 (95% CI, 4.8, 5.5, boys=5.3, girls=5.0). Figure 5.1 shows mean values for dental health indicators by the level of parents' education.

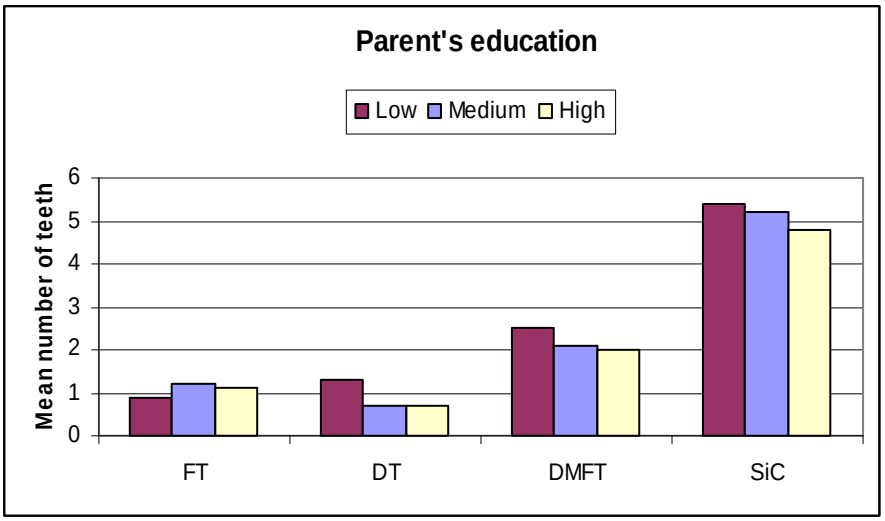

Figure 5.1. Dental health indicators (means) for 15-year-olds (n=506) in Tehran, Iran by parents' level of education.

In the bivariate analysis (Chi-square test) fewer caries cases (DT>0) occurred among 15-year-olds whose parents had a high level of education (64% vs. 52%, P=0.04), a difference among the girls (89% vs. 77%, P=0.01). No differences in these figures appeared based on area profile of the school and the wealth status of the family.

5.1.2 Gingival status

Healthy gums (CPI=0) were found in 8% of the 15-year-olds. Mean numbers of sextants for CPI scores 0, 1, and 2 were 2.1, 3.5, and 0.4, with no differences by gender or by parents' level of education (Figure 5.2).

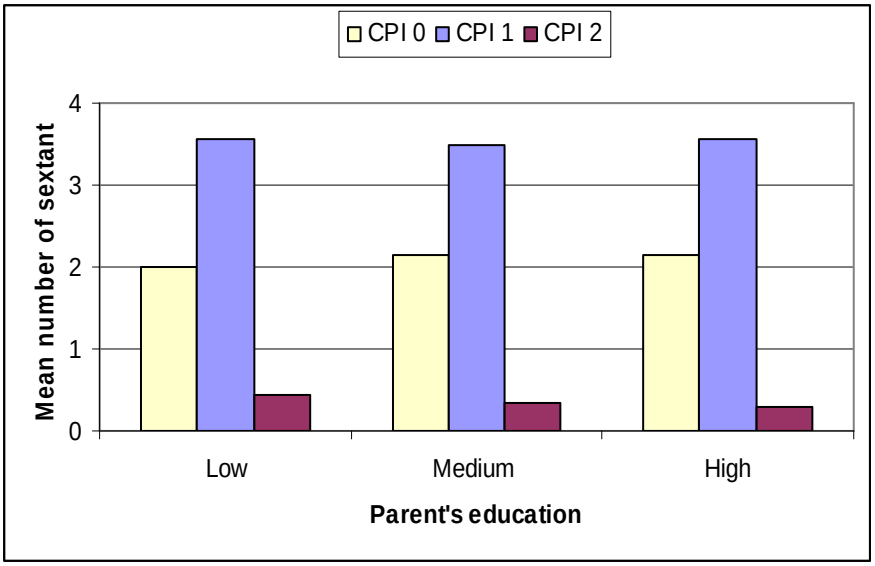

Figure 5.2. Mean numbers of sextants by CPI scores for 15-year-olds (n=506) in Tehran, Iran by parents' level of education.

Dental plaque (PI>0) existed on at least one index tooth of all 15-year-olds. Mean numbers of sextants with PI scores 0, 1, and 2 were 0.6, 2.1, and 3.3, respectively. PI=2 occurred in 83% of all students, and was most frequent (88%) among those students with less educated parents, and least frequent (77%) for those with highly educated parents (P=0.02, Chi-square test). The presence of dental plaque (PI>0) was associated with the presence of decayed teeth (P=0.01), bleeding (P=005), and with a CPI>0 (P=0.003, Chi-square test).

5.1.3 Orthodontic treatment need

A definite need for orthodontic treatment was observed in 26% of the 15-year-olds, with no gender differences. Mean numbers of DMFT (2.8 vs. 1.9, P=0.003), MT (0.4 vs. 0.1, P=0.001), and FT (1.4 vs. 0.1, P=0.04) were higher for those with orthodontic treatment need in the bivariate analysis (t-test). No relationship existed between definite orthodontic treatment need and presence of dental plaque (Chi-square test).

5.2. Objective and subjective assessment of dental health (I, III)

The vast majority (78%) of 15-year-olds assessed their dental health as good or better, with no gender differences. Based on self-assessment, 28% reported a need for a filling, 46% reported gingival bleeding, and 23% reported a need for orthodontic treatment (Figure 5.3). Boys reported gingival bleeding more often than did girls (50% vs. 42%, P=0.040), with no gender differences from other aspects of self-assessment and clinical findings in the bivariate analysis (Chi-square test). Bivariate analysis showed self-assessing one's dental health as good or better was related to parents' higher level of education among girls (P=0.03), but not among boys. Self-assessed dental health did not vary according to wealth status of the family or location of the school. More of those with their DMFT=0 (86% vs. 14%, P=0.017) and DT=0 (84% vs. 16%, P=0.021) assessed their dental health as good or better (Chi-square test).

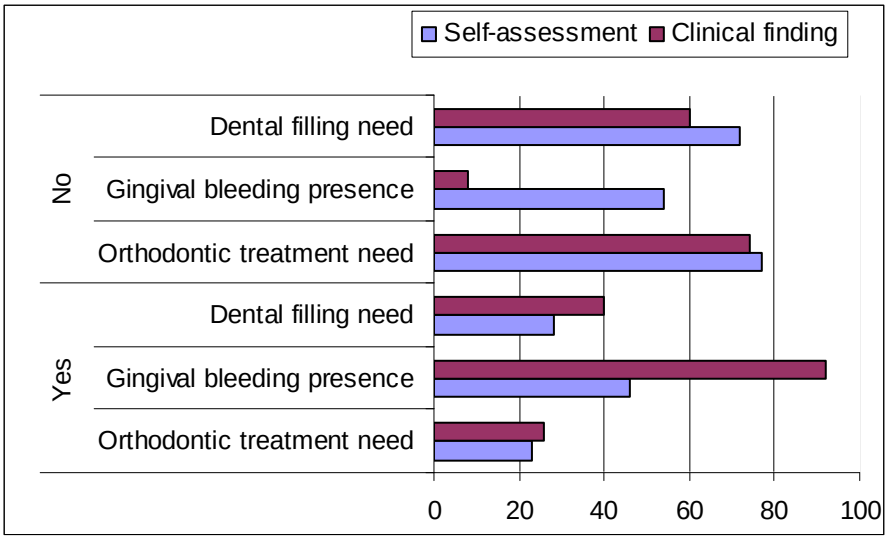

Figure 5.3. Percentages of self-assessment and clinical findings of orthodontic treatment need, gingival bleeding presence and dental filling need among 15-year-olds (n=506) in Tehran, Iran.

Sensitivity for self-assessed need for a filling, gingival bleeding presence, and need for orthodontic treatment were 42%, 49%, 37%; the corresponding specificities were 82%, 80%, and 81%. Figure 5.4 shows the measures of validity of self-assessment by gender.

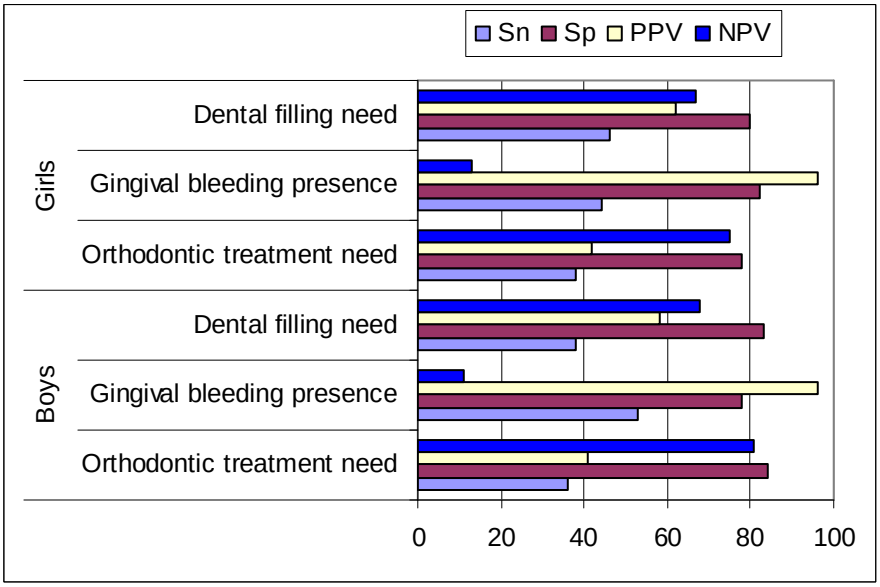

Figure 5.4. Evaluation of self-assessed aspects of dental health as indicators of clinically determined dental health among 15-year-olds (n=506) in Tehran, Iran by percentages of sensitivity (Sn), specificity (Sp), positive predictive value (PPV), and negative predictive value (NPV)**.**

In the logistic regression model, self-perceiving one's own dental health as good or better was more likely for those with sound dentition (OR=2.1, 95% CI, 1.1, 4.0), no self-assessed need for a filling (OR=2.1, 95% CI, 1.1, 3.8), a self-assessed absence of gingival bleeding (OR=2.9, 95% CI, 1.6, 5.2), and a high level of parental education (OR=1.2, 95% CI, 1.0, 1.4) when controlled for socio-demographic background information, clinical gingival and dental findings and self-assessments of gingival and dental status.

5.3. Tooth-brushing, smoking, and oral cleanliness (II)

5.3.1. Tooth-brushing

About one fourth (26%) of all students reported brushing their teeth twice daily, 42% once daily, and 32% less than daily or never, with gender differences. In the bivariate analysis (Chi-square test), higher percentages of reporting twice-daily tooth-brushing were found in girls (38% vs. 15%, P<0.001), in students from families with a good wealth status (29% vs. 18%, P=0.01) or a high level of parental education (33% vs. 17%, P=0.006), and in students attending affluent schools (32% vs. 18%, P<0.001). Twice-daily tooth brushing according to socio-economic backgrounds by gender is shown in Figure 5.5. Table 5.1 shows factors related to reporting twice-daily tooth brushing according to gender and socio-economic backgrounds, by means of logistic regression modeling. According to the logistic regression model the girls were more likely (3.1, CI 95% 1.9-4.8) to report twice-daily tooth brushing.

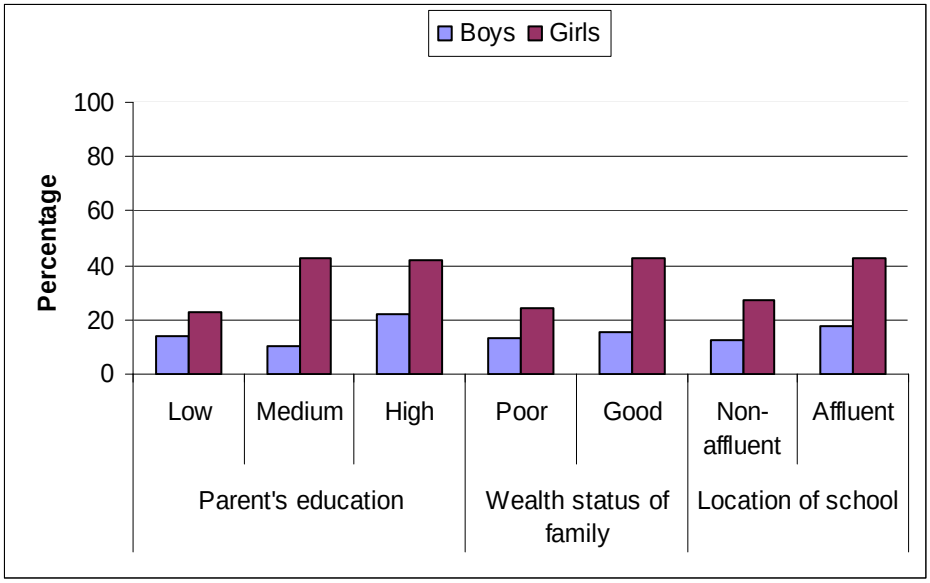

Figure 5.5. Twice-daily tooth-brushing (%) by gender, according to socio-demographic background information of 15-year-olds (n=506) in Tehran, Iran.

Table 5.1. Factors related to reporting twice-daily tooth brushing among 15-year-olds (n=506) in Tehran, Iran, according to gender and socio-economic backgrounds, by means of logistic regression modeling.

Dependent variable and parameters	Estimate of strength	SE	OR	CI 95%	p
Reporting twice-daily tooth brushing					
Gender: 0=Boy, 1=Girl	1.120	0.229	3.1	1.9-4.8	0.000
Level of parental education	0.192	0.089	1.2	1.0-1.4	0.031
Wealth status of the family: 0= Poor, 1= Good	0.528	0.261	1.7	1.0-2.8	0.043
Location of the school: 0=Non-affluent area, 1=Affluent area	0.363	0.245	1.4	0.9-2.3	0.138
Smoking: 0=Yes, 1=No	0.519	0.783	1.7	0.3-7.8	0.508
Constant	-5.969				
Goodness of fit, p-value=0.577					

The most common time for tooth-brushing was in the evening (65%). Non-smokers reported twice-daily tooth-brushing more frequently than did the smokers (26% vs. 11%); 11% of the smokers and 6% of the non-smokers reported no tooth-brushing at all.

5.3.2. Smoking

Smokers comprised 5% of the boys and 2% of the girls (P=0.02). Smoking percentages were higher for students of less-educated parents (50% vs. 30%, P=0.04). Of all students, 43% reported having smokers in the family; one-fourth of boys and 8% of girls had smokers among their friends. In the logistic regression model, non-smoking was more likely for students attending affluent schools (OR=4.3, 95% CI, 1.3, 14.3) when controlling for students' socio-demographic background information (Table 5.2). In this model gender was statistically non- significant.

Table 5.2. Factors related to non-smoking among 15-year-olds (n=506) in Tehran, Iran according to gender and socio-economic backgrounds, by means of logistic regression modeling.

Dependent variable and parameters	Estimate of strength	SE	OR	CI 95%	p
Reporting non-smoking					
Gender: 0=Boy, 1=Girl	0.995	0.584	2.7	0.8-8.5	0.089
Level of parental education	-0.115	0.193	0.8	0.6-1.3	0.549
Wealth status of the family: 0= Poor, 1= Good	0.724	0.494	2.1	0.7-5.4	0.143
Location of the school: 0= Non-affluent area, 1= Affluent area	1.472	0.609	4.3	1.3-14.3	0.016
Constant	-0.944				
Goodness of fit, p-value =0.930					

5.3.3. Oral cleanliness

Oral cleanliness, expressed as the sum of PI scores, was good for 13%, moderate for 32%, and poor for 55%. In the bivariate analysis (Chi-square test) poor oral cleanliness was most common among boys (63% vs. 37%; P<0.001) and among students of less-educated parents (64% vs. 36%; P=0.03). On average, the PI sum (maximum=12) was 8.2 for girls and 9.1 for boys (P<0.001), and the BI sum (maximum=6), 3.6 for girls and 4.0 for boys (P=0.03). The PI and BI sums were highest both on anterior and posterior teeth for those reporting less than daily tooth-brushing. All differences were statistically highly significant (Figure 5.6).

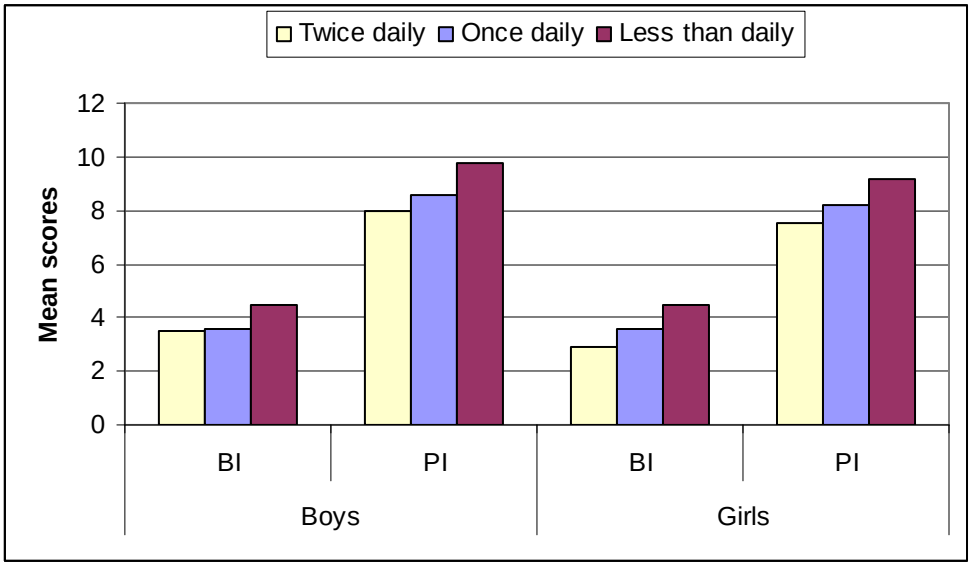

Figure 5.6. Oral cleanliness and gingival health according to frequency of tooth-brushing as sums of plaque index (PI) scores and bleeding on probing index (BI) scores of 15-year-olds (n=506) in Tehran, Iran, by gender.

For students who reported twice-daily tooth-brushing, both their anterior and posterior teeth exhibited better oral cleanliness than did the teeth of those brushing less frequently. Consequently, the PI and BI sums were highest both on anterior and posterior teeth for those reporting less than daily tooth-brushing. All differences were statistically highly significant (Chi-square test).

5.4. Educational intervention in oral cleanliness and gingival health (I, IV)

At the baseline, all students had dental plaque, and 93% had gingival bleeding on at least one index tooth. Mean sum scores for dental plaque were 8.8 (SD=2.6) (boys=9.2, girls=8.5) and for gingival bleeding 3.9 (SD=1.8) (boys=4.2, girls=3.7), with no differences between the intervention and control groups.

5.4.1. Oral cleanliness

Of all students, 84% in the leaflet group, 77% in the videotape group, and 41% in the control group showed improvement in oral cleanliness. In comparison with the control group, the improvements were statistically significant except for girls in the videotape group. In the bivariate analysis (t-test), for all index teeth, the mean sum scores of dental plaque in the leaflet, videotape and control groups were 8.8, 8.4, and 9.1 at the baseline and at the end, 4.5, 5.5, and 8.9, respectively (P=0.021) (Figure 5.7). An at least 50% improvement in oral cleanliness appeared in 58% of the students in the leaflet group, in 37% of those in the videotape group, and in 10% in the control group (P<0.001, Chi-square test). NNT was 2 for the leaflet group and 3 for the videotape group.

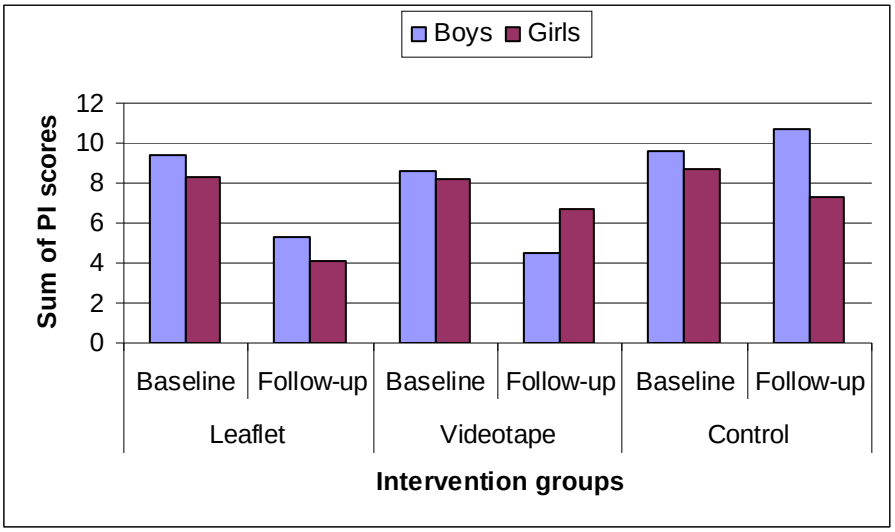

Figure 5.7. Improvement in oral cleanliness after a 12-week intervention among 15-year-olds (n=388) by gender in Tehran, Iran.

5.4.2. Gingival health

Of all students, improvement in gingival health was observed in 79% in both intervention groups and 47% in the control group. In comparison with the control group, the improvements were statistically significant. In the bivariate analysis (t-test), the mean sum scores of gingival bleeding for leaflet, videotape, and control groups were 4.0, 3.9, and 3.8 at the baseline, and at the end 1.6, 1.9, and 3.6, respectively (P=020) (Figure 5.8). At least 50% improvement in their gingival health appeared in 72% of those students in the leaflet group, in 64% of those in the videotape group, and in 30% in the control group (P<0.001, Chi-square test). NNT was 3 for both the leaflet and videotape groups.

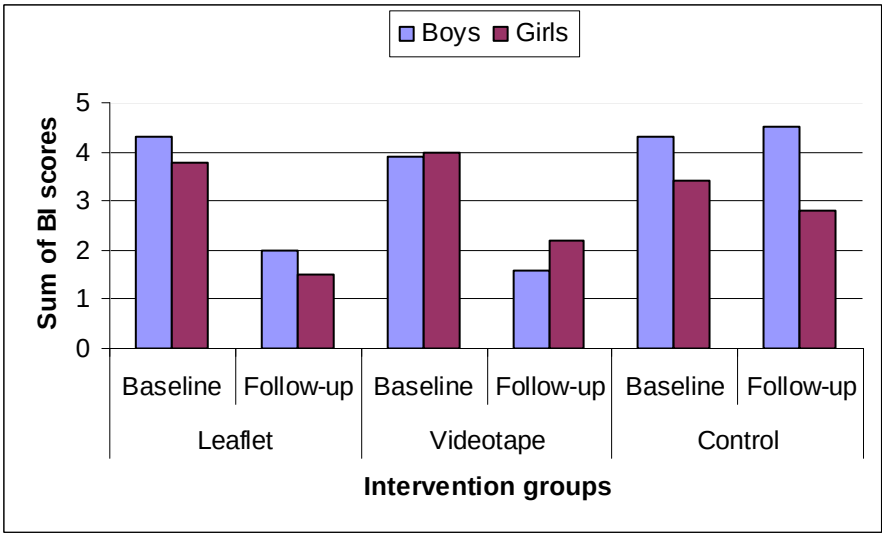

Figure 5.8. Improvement in gingival health after a 12-week intervention among 15-year-olds (n=388) by gender in Tehran, Iran.

5.4.3. Subjective evaluation of intervention

In the intervention groups, 97% of the students assessed the leaflet as good material for dental health education, with no gender difference. The respective figure for the videotape group was 83%, with a clear gender difference (91% boys vs. 72% girls, P=0.004) in the bivariate analysis (Chi-square test). Self-assessed improvement in dental health behaviours was “little” in 20%, “moderate” in 54%, and “very much” in 26% of all students in the leaflet group, with no gender differences. The corresponding improvements in the videotape group were 29%, 49%, and 22%. The boys reported greater improvements than girls (P=0.030) in the bivariate analysis (Chi-square test).

6. Discussion

6.1. General discussion

The present study assessed dental health status, health behaviours, and related factors, and evaluated the effect of school-based educational intervention on oral cleanliness and gingival health among 15-year-olds in Tehran, Iran.

Mean number of DMFT among the present 15-year-olds was low (mean=2.1; 95% CI, 1.9, 2.4). Despite the data for many developing countries where DT is the dominant component of DMFT (http://www.whocollab.od.mah.se/index.html), the present 15-year-olds exhibited a mean FT level similar to that of their mean DT. For all students, dental plaque existed on at least one index tooth, and healthy periodontium (CPI=0) was found in less than 10% of students. These results are in line with recent findings in Iran (Hessari et al., 2008). A poor level of oral hygiene and untreated decayed teeth among the present 15-year-olds call for school-based oral health-promotion activities focusing on oral self-care and improving access to dental care services.

In the present study, although 78% of adolescents assessed their dental health as good, clinical evaluation failed to confirm this finding, which indicates adolescents' poor awareness of their dental health status. School-based programmes are therefore needed to improve adolescents' knowledge about the signs of dental health diseases. In line with previous findings (Blicher et al., 2005; Dietrich et al., 2005), low sensitivity and high specificity were found for self-assessment of dental health aspects also in this study. This result shows that adolescents can detect sound teeth and healthy gingiva more precisely than they can detect disease conditions. Self-assessment can thus be a useful method for identifying adolescents free of dental health problems.

Smokers among these Iranian 15-year-olds were exceptionally rare (4%). For this age-group, despite this low percentage of smokers, smoking cessation programmes are needed. Delaying anti-smoking programmes until after the adolescent years may lead to health hazards during both adolescence and adulthood (Mermelstein, 2003). Moreover, smoking preventive programmes for non-smokers should be organised to postpone or totally discourage them from becoming smokers.

The low percentage (26%) of those reporting twice-daily tooth-brushing among these subjects shows there is still much work to be done among 15-year-olds to achieve the recommended tooth-brushing frequency. In line with previous studies (Maes and Honkala, 2006; Albandar, 2002), the present study revealed lower percentages of twice-daily tooth-brushing for boys and for those with lower socio-demographic background information. Thus, gender differences and socio-demographic background of the family should be considered in interventions to enhance tooth-brushing behaviour among adolescents. A significant result was the clear relationship between twice-daily tooth-brushing and fewer findings of dental plaque and gingival bleeding, confirmed separately both for boys and girls. For improvement of oral health behaviours, the main oral health topics can be integrated with basic subjects at schools (Vanobbergen et al., 2004). Tooth-brushing should be emphasised not only in oral health education but also in general health education in schools.

The present study has demonstrated that school-based educational intervention was successful in the short term in the improving the oral cleanliness and gingival health of adolescents with unsatisfactory oral hygiene level at baseline. This result indicates that

school-based educational intervention should be recommended in countries with a developing oral health care system, such as Iran, in order to improve oral hygiene among adolescents.

6.2. Methodological aspects of the study

The target population of the present study comprised 15-year-olds attending public schools that were selected during a multi-stage random sampling procedure from a list provided by HOET. The high rate of in high school attendance at various socio-economic levels of students in public schools in Tehran (Iran Statistical Year Book, 2002) speaks for the representativeness of the sample. The high participation rate and extremely low proportion of unanswered questions support the representativeness of the sample and the likelihood of accurate results. The students were not aware of the upcoming examination and intervention dates of both baseline and final examinations. No differences appeared among the three interventional groups according to backgrounds and baseline clinical findings. Participation in the study was voluntary; only three subjects feared and refused the clinical dental examination. Data collection was performed by two trained and calibrated dental examiners.

The limitation of the present school-based educational intervention was short-term follow-up, but the high participation rates at the baseline and scanty drop-outs in the intervention were strengths of the present study. Further research, however, is needed to establish the long-term benefits of the intervention.

For increased validity and reliability, WHO standard criteria were used to record the data (WHO, 1997). For dental caries, the DMFT index was used. DMFT is a well-accepted measure of caries prevalence to describe the actual caries experience within population studies (WHO, 1997); it describes the level of cavitation with involvement of dentine. However, the DMF index has some limitations (Benigeri et al., 1998): It gives equal weights to teeth which are missing or have untreated decay or are well-restored, further, it can overestimate caries experience if teeth have preventive restorations or have been lost for reasons other than caries. To diminish the bias of recording the M component of DMFT, in cases where the examiner doubted the reason for extraction, it was inquired at dental examinations.

To assess gingival conditions, this study used the Community Periodontal Index (CPI) because of its simplicity, speed, and international uniformity. Limitations related to the CPI index are: 1) recording of index teeth, 2) hierarchy of scoring, and 3) possibly being too simple and crude (Pilot and Miyazaki, 1994). According to WHO recommendations for the use of the CPI index for 15-year-olds, only the codes from 0 to 2 were used in the present study, thus avoiding complications related to measuring periodontal pockets (Pihlstrom, 1992). The WHO still recommends using the CPI index to increase international uniformity of epidemiological field studies on periodontal findings (WHO, 1997).

The Plaque Index (PI) of Silness and Löe (1964) was modified for recording of dental plaque. Generally, PI has been shown to be a reliable measure in earlier studies for evaluating outcome of mechanical anti-plaque procedures and level of oral hygiene in educational oral health interventions (Vanobbergen et al., 2004; Kay and Locker, 1996). In the present study, PI seemed to be a sensitive measure for these 15-year-olds with abundant plaque findings, to reveal changes in their oral hygiene levels.

For orthodontic treatment needs, the Modified IOTN Index was used. The validity and reliability of the IOTN have been established by several studies (Younis et al., 1997; Richmond et al., 1995). The IOTN index has also been modified (Burden et al., 2001) to ensure greater reliability, especially when used by non-specialist dentists. The Modified IOTN Index with two categories (need/no need) made it more suitable and practical for the present study by a non-specialist dentist with a short training period.

The framework of a self-administered structured questionnaire was based on the Second International Collaborative Study (ICSII) (Chen et al., 1997) and other validated questions (Östberg et al., 2003; Locker, 1996). The ICSII questionnaire is a valid and reliable questionnaire, used and tested in many studies. Thus it serves as a good reference for comparison with the present study results. In order to obtain a true picture of the situation it was pointed out to the students that the data would be analyzed anonymously, with a numerical code only. However, as in any questionnaire study, a tendency to give favourable responses, also referred to as social desirability (Sjöström and Holst, 2002), might have affected the respondents' answering. An overestimation of recommended oral health behaviours may have been occurred in the present study. Regarding smoking, this situation might be the reverse, because of the low frequency reported.

For oral health, poor oral hygiene practices, sugar, and alcohol consumption, and smoking are risk behaviours (Petersen, 2003). Dental plaque is the direct cause of periodontal diseases and without plaque, there will be no caries even with frequent additions of sucrose to the daily diet (Löe, 2000). Therefore good oral hygiene practices, including tooth-brushing with fluoride toothpaste, are major factors to contribute to prevention of dental caries and periodontal diseases. Snacking and use of sugar-containing drinks during the school hours is not customary in Iran. Adolescents' dietary habits are closely related to the family culture and, consequently, beyond their control. Therefore, the present study concentrated upon those behaviours about which the adolescents are making their own decisions.

The feasibility of the study was tested prior to the study by conducting a pilot study in a public school class. Through discussions with the participants and assessment of the results of the pilot study, the questionnaire and examination form were revised. Only minor changes were carried out after the pilot study such as omitting some questions and adding some new alternative responses to provide a wider range of possible answers.

6.3. Results of the study

6.3.1. Dental health status and treatment needs

In the present study, the mean number of DMFT compared with data available for 15-year-olds in the WHO regional offices (http://www.whocollab.od.mah.se/index.html), except for the South East Asia Regional Office, was low. The prevalence of untreated decay teeth was, however, high (40%). The high prevalence of dental caries and untreated decayed teeth in developing countries may be in part due to developing oral health systems with insufficient service coverage (Petersen, 2003). In a low population: dentist-ratio (1:5,500) country such as Iran (Pakshir, 2004) regular dental screening programmes with auxiliary dental professionals within schools could be beneficial. Students with dental problems can thereby be detected and referred to oral health centres for treatment and also to prevention services. However, from a public health point of view, it seems impractical to control oral disease only by curative strategies. Thus, the continuous implementation of school-based oral health promotion and prevention is needed, particularly among adolescents, in Iran.

The present findings of the poor level of oral hygiene and high proportion of 15-year-olds with gingival bleeding and calculus are in line with previous findings from many developing countries (Albandar and Tinoco, 2002; Corbet et al., 2002; WHO oral health country/area profile). A school-based approach to reach this young population seems to be essential. The provision of oral health education in schools, with an emphasis on proper instructions for oral hygiene practices, would improve Iranian adolescents' oral hygiene, and thus reduce their long-term risk for caries and periodontal diseases.

6.3.2. Objective versus subjective evaluation of dental health

More than two-thirds of the students were pleased with their own dental health status. This finding is in line with earlier studies among adolescents (Jiang et al., 2005; Östberg et al., 1999; Chen et al., 1997). No self-assessed need for a filling and intact teeth in the clinical examination were predictors for reporting good self-perceived dental health. However, the clinical findings did not confirm the results in self-perceived dental health completely, and thus indicate a low level of knowledge and awareness of students regarding their dental health problems. A weak correlation between clinical findings and self-assessed dental health has been reported in the previous studies (Östberg et al., 2003; Kallio, 1996). Clinical indices usually reflect more the providers' view than the patients' aspect (Chestnutt et al., 2006; Goodman et al., 2004; Östberg et al., 2003). School-based educational programmes teaching about the signs of dental and gingival problems may improve adolescents' level of knowledge and awareness, allowing for more precise self-assessments.

Based on the sum of sensitivity and specificity percentages (Blicher et al., 2005), the validity of students' self-assessments was good, except for orthodontic treatment need. Socio-cultural factors, individual expectations, methods, and type of questions (Blicher et al., 2005; Locker, 2000), attitudes and belief about oral health (Östberg et al., 2001) all are factors that affect the validity of the self-perceived oral health questionnaire. The results of comparing self-assessed dental health and clinical results vary in validity. A clinical finding of orthodontic treatment need is usually higher than is subject's perception (Chestnutt et al., 2006). The validity of dental caries and periodontal disease in self-assessment is less than clinical evaluation (Goodman et al., 2004; Östberg et al., 2003; Kallio, 1996). The percentage of self-assessed gingival bleeding was lower than found in the clinical examination. An individual with occasional or minor gingival bleeding may not assess that as a sign of disease, but the dentist is able to detect the very slight bleeding on probing (Buhlin et al., 2002). Consequently, correlations between self-assessed gingival bleeding and clinical findings usually are weak, lower than clinical findings (Östberg et al., 2003; Kallio, 1996). However, self-assessed gingival bleeding can be a useful method in population study (Kallio, 1996); in the present study, self-assessed absence of gingival bleeding was the strongest predictor for reporting good or better self-perceived dental health.

In line with studies on various age-groups (Blicher et al., 2005; Dietrich et al., 2005; Buhlin et al., 2002; Gilbert and Nuttall, 1999), low sensitivity and high specificity were common results concerning self-assessment of dental health indicators also among our subjects. Low sensitivity and high specificity in self-assessment of dental health indicators show that students detect healthy conditions more accurately than disease conditions. Therefore, self-assessment can be a useful method for detecting students who enjoy a healthy dental condition allowing intermediate dental manpower such as dental hygienists and dental nurses and even volunteer school teachers to help in detecting students in a healthy condition by means of a self-assessment questionnaire. After this stage, a student in an unhealthy dental condition could be referred for further oral health evaluation by a dentist.

6.3.3. Tooth-brushing and smoking

Recommended twice-daily tooth-brushing was reported by only one-fourth of the 15-year-olds studied. In Europe and North America the corresponding percentages for adolescents range from 18% to 86% (Maes and Honkala, 2006), whereas in the Easter Mediterranean Region, in countries such as Jordan, Saudi Arabia, and Sudan, they range from 33% to 62% (Darout et al., 2005; Farsi et al., 2004; Rajab et al., 2002). In Iran, it seems to be a demanding challenge to reach the goal of twice-daily tooth-brushing, since no more than 57% to 67% of dental educators, dental students, and dentists themselves perform twice-daily tooth-brushing (Ghasemi et al., 2007; Khami et al., 2007, 2006). These percentages are lower than expected for dental professionals, probably reflecting their poor attitudes toward preventive dentistry and thus also their everyday practice concerning their patients. Emphasis on oral self-care in the dental curriculum and continuing education is therefore necessary, in Iran.

Twice-daily tooth-brushing in the present study was more frequent among girls than among boys, a finding which seems widespread among adolescents (Maes and Honkala, 2006; Chen et al., 1997). Therefore, at individual level in research and in interventions, gender differences should be noted in order to enhance tooth-brushing behaviour. The most common tooth-brushing times were in the evening and in the morning, and in general, those who brush in the morning seem to favour more social reasons (fresh breath, clean mouth), whereas those brushing in the evening before bed do so more for dental health reasons (Macgregor et al., 1996). Tooth-brushing behaviour should be an integral part of one's lifestyle, not isolated from other health practices and social factors (Macgregor et al., 1996). Tooth-brushing should be noted as a health behaviour in school-based health promotion programmes, particularly in countries such as Iran with a developing oral health system. In line with previous studies (Maes and Honkala, 2006; Albandar, 2002), twice-daily tooth-brushing was more frequent among students with higher socio-demographic background information, thus, reflecting the value such families place on proper oral self-care. This fact should be noted as support for the priority of implementing school-based oral health programmes in regions with low socio-economic level.

A clear relationship appeared between a higher frequency of tooth-brushing and better oral hygiene for both genders, a positive sign of the role of tooth-brushing frequency in dental and gingival health; not only tooth-brushing frequency but also quality of tooth-brushing is important (Murray et al., 2003). Therefore, improving the quality of tooth-brushing should be emphasised in clinical settings and in oral health care programmes.

Smoking is an important public-health problem in the world (Petersen, 2003; Surgeon General's Report, 2000). Smoking behaviour is generally established during adolescence (Machay and Eriksen, 2002). Furthermore, early initiation of smoking is predictive of alcohol-related problems and illicit drug use in late adolescence and young adulthood (WHO, 2008). Thus, smoking could be considered as one of the most important behavioural determinants of dental and general diseases among adolescents.

Discolorations of teeth and dental restorations, halitosis, diminished taste and smell, periodontal diseases, increased dental caries, impaired wound healing, oral cancer and precancerous lesions are harmful effects of smoking in the oral cavity (Johnson and Bain, 2000). Smoking is harmful not only for smokers, but also as passive smoking. It can increase allergic and asthmatic attacks and reduce lung function (Zhou et al., 2006; Barnoya and Glantz, 2005).

A comparison of the smoking prevalence in this study and prevalences from developed and developing countries (Almas et al., 2002; Machay and Eriksen, 2002; Yorulmaz et al., 2002) shows that among adolescents, smoking in Iran is still infrequent. In Iran, traditional, social, and cultural beliefs may, however, have led to underreporting of smoking. Since it is an unacceptable habit, especially among girls, most parents strictly forbid their children to smoke. Among the present adolescents, smoking was less prevalent among girls. Regardless of the low rate of reported smoking among adolescents, however, it seems to increase according to changes in society. Furthermore, strong continuity of smoking from adolescence to adulthood (Vartiainen et al., 1998) supports the importance of preventing smoking in adolescence. Therefore, smoking cessation and prevention programmes for this age group should be organised at schools, in Iran.

More smokers than non-smokers reported having smoking friends, and a smoking friend is an indicator for initiating smoking among adolescents (Forrester et al., 2007). In the USA, over 90% of secondary school students who smoke also have a smoking friend (Centers for Disease Control and Prevention, 2001). Friends play a significant role in adolescents' smoking (Hoffman et al., 2007). Peer-led approaches to smoking cessation in schools have been shown to be effective in reducing smoking among adolescents (Campbell et al., 2008), and such smoking prevention and cessation programmes thus can be recommended for Iran.

In the present study, the commencement of smoking at 15 years of age is in agreement with figures from previous studies in Iran (Sarrafzadegan et al., 2004) and in Turkey (Yorulmaz et al., 2002). Since half those who begin smoking in adolescence will continue their smoking for the next 15 to 20 years (WHO, 2007), anti-smoking programmes for adolescents should be organised either to postpone it or to totally discourage them from becoming smokers, and thus avoid the long-term health hazards of smoking. Attention to adolescents' smoking cessation has obviously increased over the past several years, as researchers and practitioners have become aware of the high occurrence of regular smoking among adolescents and the low probability that they will stop on their own (Mermelstein, 2003).

Oral health professionals in the community setting or in dental offices have an effective occasion for aiding in successful tobacco cessation. A dental professional's advice can effectively motivate smokers to quit smoking (Johnson, 2004), even with a brief intervention (Gordon et al., 2005). Behavioural interventions against smoking carried out by oral health professionals and incorporated into the clinical dental examination have raised tobacco cessation rates among tobacco users (Carr and Ebbert, 2006).

In Iran, 24% of dentists have reported themselves as being smokers (Ghasemi et al., 2007), which is above the average in international comparison of dental professionals (Smith and Leggat, 2006). Iranian dentists' high percentage of reported smoking also reflects their infrequent activity in encouraging smoking cessation for their patients (Ghasemi et al., 2008). More emphasis should thus be placed on the role of dentists in smoking cessation and prevention among Iranian adolescents.

Schools provide a place for communicating with a large proportion of young people and provide consistent access to them over several years. School-based programmes for smoking prevention have been widely developed and evaluated. Well-conducted randomized controlled trials have been shown to reduce adolescents' smoking (Thomas and Perera, 2006). For countries such as Iran with a young population and a high (70%) high-school

attendance rate, school-based programmes should applied to smoking prevention among adolescents.

6.3.4. Educational intervention in oral cleanliness and gingival health

Whether or not an intervention can be suggested for general use will depend on the balance between inputs and outputs and spending of health care resources. The cost, time and manpower of educational interventions are important factors in interpretation of intervention findings (Kay and Locker, 1996). Cost-effectiveness and needing fewer resources for educational intervention are positive points for recommendation. Producing the education materials for the present study was inexpensive: for the leaflet 2000 Rials (0.15 €) and for the videotape 3000 Rials (0.2 €) per student. No extra staff was needed for educational interventions because they were carried out by arrangements with school authorities and teachers who volunteered. This showed that a school-based, easy-to-organize, and inexpensive educational intervention can be effective in the short-term in improving oral cleanliness and gingival health in 15-year-olds with poor oral hygiene. Further research, however, is necessary to establish the long-term benefits of educational interventions.

In a population with low levels of oral hygiene and limited resources for oral health care, such as Iran, it is reasonable to empower the adolescents to promote their dental health and to prevent oral diseases through dental health education. Oral health promotion programmes in schools should be set as a high priority goal for health policy in Iran. This means that educational activities also need to be targeted at decision-makers for building a supportive environment in Iran to minimize or eliminate risky behaviours.

According to a communication-behaviour change model (McGuire, 1984), oral health educational programmes can be designed based on information-persuasion strategy, which serves to influence knowledge and attitudes. Information can come via health messages in educational materials such as leaflets, and this can change individuals' behaviours (Overton Dickinson, 2005; McGuire, 1991). The methods of communication differ in different educational systems for acquiring knowledge particularly in a community such as Iran with a low level of oral hygiene and oral health knowledge. A communication behaviour approach might therefore be effective in improving the oral hygiene of adolescents in Iran.

People have different learning styles or characteristics for processing information, feeling, and behaving in any learning situation. Base upon differences in learning styles, various educational methods can serve in oral health educational programmes (Overton Dickinson, 2005). Verbal, written, and audio-visual methods are three main modes for oral health education (Kay and Locker, 1996, 1998). Written materials are usually less effective than videotape (Lees and Rock, 2000). In communities with low levels of oral hygiene and limited manpower resources, written and audio-visual educational methods can be useful in improving oral health status (Lim et al., 1996).

Educational interventions which aim to reduce plaque levels and improve gingival health can be successful (Kay and Locker, 1996). However, compared with previous interventional (Petersen et al, 2004; Biesbrock et al., 2003; Sri Wendari et al., 2002; Van Palenstein Helderman et al., 1997; Stewart et al., 1991) and review findings (Hausen, 2005; Kay and Locker, 1998, 1996), improvements in oral cleanliness and gingival health in the present study were more obvious. The poor level of oral hygiene of adolescents at the baseline and their receiving an educational intervention probably for the first time in their lives may have been reasons for this obvious improvement. Based on the present results, however, it seems

possible to have good effects of school-based educational intervention among adolescents in the short-term. School-based educational intervention should therefore be implemented among adolescents in Iran for improving their oral hygiene.

In the present study, the educational materials demonstrated the role of dental plaque and the importance of frequency and methods of proper tooth-brushing and flossing, the significance of regular dental attendance, healthy diet, and proper use of fluorides in achieving and maintaining good oral health. Since immediate gains of good oral hygiene have been shown to motivate adolescents to achieve good oral hygiene more than do the long-term advantages (Redmond et al., 2001), the immediate gains of good oral hygiene, such as fresh breath, clean teeth, and attractive appearance were used as additional motivational tools. This multifaceted approach might have led to the good results found in this study.

At the end of the intervention, improvement in oral cleanliness and gingival health was found among the girls also in the control group. It has been reported that exposing students to a dentist's examination and a questionnaire (Baranowski et al., 2006) can have positive effects on their oral hygiene. Despite this trial effect, however, in the present study, the significant improvements in the intervention groups seem to speak for the true effect of the intervention.

Adolescents in the leaflet group showed greater improvement in oral cleanliness and gingival health than did those in the videotape group. Good acceptance of a leaflet by adolescents and its stimulation of improved oral health behaviour have been reported in a UK study (Redmond et al., 2001). Additionally, in the present study, adolescents in the leaflet group assessed the leaflet as leading to better improvement in their oral health behaviours than did adolescents in the videotape group. This may be due to these adolescents' being more familiar with traditional learning methods or to the fact that the videotape was not interesting enough to encourage the adolescents toward better oral health behaviour. The leaflet could be read several times and on any occasion, and all students had one leaflet each, but the videotape could be watched on only two occasions.

Boys in the videotape group showed more improvement in their oral cleanliness and gingival health than did girls. This result could be related to the gender preferences for educational materials found earlier (Redmond et al., 2001) and should be noted when planning the school-based oral health interventions.

7. Conclusions

1. Poor oral hygiene among Iranian adolescents is related to their low percentage of reported twice-daily tooth-brushing.
2. Poor gingival health among Iranian adolescents indicates their low quality and quantity of tooth-brushing.
3. Self-assessment is a useful method for detecting a healthy dental condition but not in screening for dental diseases among adolescents, especially in countries with a developing oral health care system.
4. Implementing an easy-to-organize and inexpensive school-based educational intervention can improve oral cleanliness and gingival health among adolescents in the short term, in particular, in countries with a developing oral health care system. However, a challenge for future research is to evaluate the long-term effects of similar interventions.

8. Recommendations

1. School-based dental health education activities focusing on oral self-care and key dental health educational messages should be established for adolescents, giving special attention to boys, and to those from a lower socio-economic background.
2. For early detection of adolescents' dental health problems, self-assessment procedures should be applied to support regular dental screenings at schools.
3. For adolescents, anti-smoking activities should be included in school-based oral health-promotion programmes.
4. Oral health programmes should be integrated into general health programmes in schools with the involvement of parents. These programmes should apply a common risk-factor approach to optimize benefits by providing for both general and dental health.
5. In-service training should be provided for teachers and other school staff on how to promote general and oral health of adolescents.
6. Oral health promotion programmes should be continued from primary school up to high school in Iran.

9. Summary

Despite the dramatic decline in dental caries, the oral hygiene of adolescents in many countries is still unsatisfactory. Low levels of gingival health and oral cleanliness are common in school-aged children worldwide. In Iran, the general level of oral health is unacceptable, mainly among school children, although Iran is in the category of countries with low levels of caries prevalence according to DMFT value in the adolescent age-group. However, the high numbers of untreated decayed teeth, low levels of healthy gums, and tooth-brushing less than at recommended frequency among adolescents are alarming findings necessitating oral health promotion programmes.

The general aim of the present study was to assess dental health and its determinants and to evaluate impacts of school-based educational intervention on the oral cleanliness and gingival health of 15-year-olds. To achieve this aim, the following specific objectives were set: 1. To assess dental and gingival status and orthodontic treatment needs among 15-year-olds. 2. To compare self-perceived and clinically determined findings in dental health. 3. To study tooth-brushing and smoking behaviours and their relationships. 4. To evaluate school-based educational intervention to improve oral cleanliness and gingival health.

The present study design was cross-sectional in the observational part and prospective in the interventional trial part. The study population included 15-year-olds in the capital city, Tehran, in public schools. A multi-stage random sampling procedure included selection of 17 public schools from the list provided by the Head Office for Education of Tehran. The total sample comprised 506 15-year-olds, 260 boys and 246 girls. Data collection was performed according to clinical examination and self-administered structured questionnaire based on WHO criteria and the Second International Collaborative Study (ICSII). The questionnaire covered questions about background, socio-economic status, self-perceived dental health, tooth-brushing, and smoking behaviours. Participation was voluntary, and all students responded to questionnaire; only three students refused clinical dental examination.

Recordings of dental findings were for all teeth by tooth and of periodontal findings for the six index teeth (16, 11, 26, 36, 31, and 46). Dental health status was described by the following indices: Decayed, Missing, and Filled Teeth (DMFT), the Community Periodontal Index (CPI), Bleeding on probing (BI), the Modified Orthodontic Treatment Needs index (IOTN), and the Plaque Index (PI).

For the intervention, 14 school classes, one each from 14 schools (n=417 students) were chosen, based on agreement of the school authorities from among the 17 schools that participated in the cross-sectional study. Then, these 14 classes were randomly divided into three groups, a leaflet (five classes, n=148), a videotape (five classes, n=139), and a control (four classes, n=130) group. The intervention was based on exposing students to dental health education through a leaflet and a videotape designed for the present study. The

follow-up data were collected 12 weeks after the baseline examination. The drop-out rate was 7%. The intervention was evaluated by assessing improvements in oral cleanliness and gingival health in the intervention groups in comparison to the control group.

The mean number for DMFT was 2.1, which comprised DT=0.9, MT=0.2, and FT=1.0, with no gender differences. An intact dentition (DMFT=0) was found in 40% of the 15-year-olds (44% of boys and 37% of girls). Fewer caries cases were found among 15-year-olds whose parents had a high level of education, a difference most obvious among the girls.

Less than 10% of students had healthy gums without bleeding. All students had dental plaque on at least one index tooth. Mean numbers of sextants with PI scores 0, 1, and 2 were 0.6, 2.1, and 3.3, respectively. Poor oral hygiene was evident among students whose parents had a low level of education. A definite need for orthodontic treatment was observed in 26% of these 15-year-olds.

More than two-thirds of the students (78%) were pleased with their dental health status, with no gender differences. However, this finding remained unconfirmed by clinical evaluation, and shows the students' low awareness of their actual dental health status. A low sensitivity and high specificity was found as to self-assessment of dental health indicators among students. This result suggests that students can detect healthy conditions more accurately than disease conditions.

The smoking percentages were low, and smokers comprised 4% of all students. The smoking percentage was higher for students of less-educated parents. Of all students, 43% reported having smokers in the family; 24% of boys and 8% of girls had smokers among their friends.

Of all students, 26% reported brushing their teeth twice daily. A higher percentage of twice-daily tooth-brushing was reported by girls, by students from families with a good wealth status or a high level of parental education, and by students attending affluent schools. The PI and BI sum scores were highest both on anterior and posterior teeth for those reporting less than daily tooth-brushing.

The present study demonstrates that a school-based, easy-to-organize, and inexpensive educational intervention can be effective in the short term in improving oral cleanliness and gingival health in 15-year-olds with poor oral hygiene.

This study has highlighted the fact that poor oral hygiene is a major problem for Iranian 15-year-olds. Establishing a school-based educational intervention can be an effective way to improve oral hygiene in this age-group. School-based intervention should be focused on oral self-care and key oral health education messages.

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Reza Yazdani
Helsinki
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Appendices

Appendix 1. Study questionnaire

Dental health among 15-year-olds in Tehran, Iran

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To the participants in this study;

Thank you very much for participating in this study.

The aim of this questionnaire study is to provide baseline data necessary for improving the dental health status of students in Tehran. The results of this study will ultimately help to promote the dental health of our community. This is not a test. However, it is important that you answer all the questions.

Read all instruction carefully and answer each question as best you can. If you do not understand the instruction or are puzzled about a particular question, raise your hand and the interviewer will come to your desk to answer your question.

For most questions, you answer by circling the number next to the answer you want to give.

Thank you for your cooperation.

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Please circle the number or numbers for appropriate answer for each question

1. Gender:

1. Male 2. Female

2. Do you live in a rented house?

1. Yes 2. No

3. What is the highest level of your father education?

1. Illiterate
2. Primary school
3. Secondary school
4. High school
5. Diploma
6. University degree

4. What is the highest level of your mother education?

1. Illiterate
2. Primary school
3. Secondary school
4. High school
5. Diploma
6. University degree

5. How often do you usually brush your teeth?

1. Irregular or never
2. Once a week
3. A few (2-3) times a week
4. Once a day
5. More than once a day

6. When do you usually brush your teeth? (Mark all describing your behaviour)

1. In the morning
2. In the evening
3. After meals
4. After eating sweet snacks
5. I do not brush

7. Do your parents or relatives living in your home smoke cigarettes?

1.Yes

2. No

8. Does any of your friends smoke cigarettes?

1. Yes

2. No

9. Do you smoke cigarettes?

1. Yes

2. No

10. How old were you when you first tried smoking?

1. I have never smoked cigarette
2. 7 years old or younger
3. 8 or 9 years old
4. 10 or 11 years old
5. 12 or 13 years old
6. 14 or 15 years old

11. How would you describe your dental health?

1. Excellent
2. Very good
3. Good
4. Poor
5. Very poor
6. Do not know

12. If you were to go to a dentist right now for an examination, do you think the dentist would say to you?

You need fillings	Your teeth need straightening
1. Yes 2. No	1. Yes 2. No

13. When do you have bleeding from your gums?

1. While brushing teeth
2. While eating hard things (such as an apple)
3. Spontaneously
4. I have not noticed bleeding from my gums

Subjective evaluation questions in the interventional part

1. The videotape/leaflet was a good material for dental health education.

1. Strongly agree 2. Agree 3. Disagree
4. Strongly disagree 5. I do not know

2. How much improvement in your oral health behaviors did happen after watching the videotape/reading the leaflet?

1. Little 2. Moderate 3. Very much.

THIS FINISHED OUR STUDY. THANK YOU VERY MUCH FOR YOUR HELP.

Appendix 2. Oral examination form

Student name: **School name:** **Date:**

Area Code **Identification Number** **Sex 1=Male 2=Female**

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PERIODONTAL STATUS

CPI

16	11	26
46	31	36

0 = Healthy
1 = Bleeding
2 = Calculus

Modified IOTN

0 = No need
1 = Defined need □

DENTITION STATUS

17	16	15	14	13	12	11	21	22	23	24	25	26	27
47	46	45	44	43	42	41	31	32	33	34	35	36	37

S-sound
D-decayed
F-filled
M-missing
9-excluded tooth

DMFT

□□

DT	
MT	
FT	

PI

0 = No Plaque
1 = On gingival margin only
2 = Elsewhere

16	11	26
46	31	36